



01/10/2014 Giovanni Salvador

DC10683

AN00170: Interfacing FlashRunner with Maxim Teridian 71M65xx Devices

FlashRunner is a Universal In-System Programmer, which uses the principles of In-Circuit Programming to program Maxim Teridian 71M65xx family microcontrollers. This Application Note describes how to properly set up and use FlashRunner to program 71M65xx Flash devices.

This Application Note assumes that you are familiar with both FlashRunner and the main features of the 71M65xx family. Full documentation about these topics is available in the FlashRunner user's manual and in device-specific datasheets.



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1. Introduction

In-system programming of 71M65xx microcontrollers is performed through the ICE interface.

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.

Thanks to its in-system programming capabilities, FlashRunner allows you to program or update the content of the Flash memory when the chip is already plugged on the application board.



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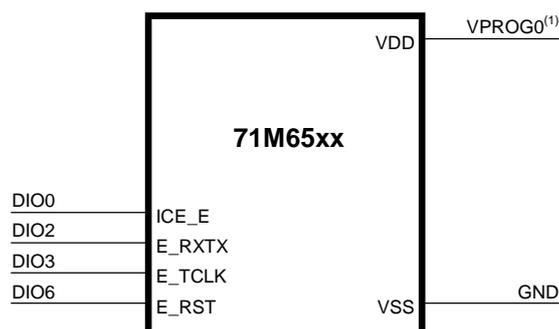
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2. Hardware Configuration

The microcontroller's lines needed to program a 71M65xx device are the following:

- **ICE_E:** Enable ICE interface (71M652X and 71M543X only). Input to DUT.
- **E_TCLK:** Data clock. Output from DUT.
- **E_RXTX:** Data input/output. Bi-directional signal.
- **E_RST:** Flash programmer Reset (active low). Bi-directional signal.
- **VDD:** Device power supply voltage.
- **VSS:** Device power supply ground.

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



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

3. Specific TCSETPAR Programming Commands

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):

- VDD voltage;
- VDD_AUX voltage;
- Power Up time;
- Power Down time;
- Reset Up time;
- Reset Down time;
- Reset Drive mode;
- Reset Exit mode.

TPSETPAR VDD

Command syntax:

```
TCSETPAR VDD <voltage mV>
```

Parameters:

voltage mV: Target device supply voltage, expressed in millivolts.

Description:

This command is used to properly generate the voltage level of the E_RST, E_TCLK, E_RXTX and ICE_E signals. Additionally, the specified voltage is routed to the VPROG0 line of the FlashRunner's "ISP" connector, which can be used as a supply voltage for the target board.

TPSETPAR VDD_AUX

Command syntax:

```
TCSETPAR VDD_AUX <voltage mV>
```

Parameters:

voltage mV: Auxiliary supply voltage, expressed in millivolts, in the range 3000-14500mV.

Description:

This command is used to generate an optional, auxiliary voltage level for user purposes. The specified voltage is routed to the VPROG1 line of the FlashRunner "ISP" connector.

A value of 0 drives the VPROG1 line to GND. If the **TCSETPAR VDD_AUX** is not sent, the VPROG1 line is driven to HiZ.

TPSETPAR PWUP

Command syntax:

```
TCSETPAR PWUP <time ms>
```

Parameters:

time ms: Power rising time, expressed in milliseconds.

Description:

This command is necessary because, to enter the programming mode, FlashRunner must properly drive the V_{DD} line during the power-on reset.

The V_{DD} rising time (PWUP) is expressed in milliseconds and depends on the features of your target board. Make sure to choose a value large enough to ensure that the V_{DD} signal reaches the high logic level within the specified time. Note that, if the V_{DD} line has a high load, a longer time is required for the V_{DD} signal to reach the high logic level. If PWUP is not long enough, FlashRunner could not be able to enter the programming mode.

TPSETPAR PWDOWN

Command syntax:

```
TCSETPAR PWDOWN <time ms>
```

Parameters:

time ms: Power falling time, expressed in milliseconds.

Description:



The V_{DD} falling time (PWDOWN) is expressed in milliseconds and depends on the features of your target board. Make sure to choose a value large enough to ensure that the V_{DD} signal reaches the low logic level within the specified time. Note that, if the V_{DD} line has a high load, a longer time is required for the V_{DD} signal to reach the low logic level.

TPSETPAR RSTUP

Command syntax:

```
TCSETPAR RSTUP <time µs>
```

Parameters:

time µs: Reset rising time, expressed in microseconds.

Description:

The Reset rising time (RSTUP) is expressed in microseconds and depends on the features of your target board. Make sure to choose a value large enough to ensure that the Reset signal reaches the high logic level within the specified time. Note that, if the Reset line has a high load, a longer time is required for the Reset signal to reach the high logic level. If RSTUP isn't long enough, FlashRunner could not be able to enable the ICE interface.

TPSETPAR RSTDOWN

Command syntax:

```
TCSETPAR RSTDOWN <time µs>
```

Parameters:

time µs: Reset falling time, expressed in microseconds.

Description:

The Reset falling time (RSTDOWN) is expressed in microseconds and depends on the features of your target board. Make sure to choose a value large enough to ensure that the Reset signal reaches the low logic level within the specified time. Note that, if the Reset line has a high load, a longer time is required for the Reset signal to reach the low logic level.

TCSETPAR RSTDRV

Command syntax:

```
TCSETPAR RSTDRV PUSHPULL|OPENDRAIN
```

Options:

PUSHPULL: Reset line is driven in push-pull mode.

OPENDRAIN: Reset line is driven in open-drain mode.

Description:

It specifies in which way FlashRunner drives the Reset line.

TCSETPAR RST_EXIT

Command syntax:

```
TCSETPAR RST_EXIT LOW|TRISTATE
```

Options:

LOW: Reset line is driven low after script execution.

TRISTATE: Reset line is set in tristate after script execution.

Description:

It specifies in which mode FlashRunner leaves the Reset line after a script execution. If this parameter is not set, the reset signal will be set to tristate after a script execution.



Specific TPCMD Programming Commands

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.

Maxim Teridian 71M65xx-specific target programming commands are the following:

- **TPCMD MASSERASE;**
- **TPCMD BLANKCHECK;**
- **TPCMD PROGRAM;**
- **TPCMD VERIFY;**
- **TPCMD READ;**
- **TPCMD DUMP;**
- **TPCMD RUN.**

TPCMD MASSERASE

Command syntax:

TPCMD MASSERASE F

Command options:

F: Specifies Flash (**F**) memory.



Description:

It erases the whole Flash (**F**) memory.

TPCMD BLANKCHECK

Command syntax:

```
TPCMD BLANKCHECK F <tgt start addr> <len>
```

Command parameters and options:

- F**: Specifies Flash (**F**) memory.
- tgt start address**: Device memory location from where the blankcheck operation will start.
- len**: Number of locations to be blankchecked.

Description:

It blankchecks Flash memory. It blankchecks **len** locations starting from the address specified by **tgt start address**.

TPCMD PROGRAM

Command syntax:

```
TPCMD PROGRAM F <src offset> <tgt start addr> <len>
```

Command parameters and options:

- F**: Specifies Flash (**F**) memory.
- 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:

It programs **len** locations of Flash memory (**F**) starting from the **tgt start addr** address.

TPCMD VERIFY

Command syntax:

```
TPCMD VERIFY F <src offset> <tgt start addr> <len>
```

Command parameters and options:

F: Specifies Flash (**F**) memory.

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

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

len: Number of locations to be verified

Description:

It verifies **len** locations of Flash memory (**F**) starting from the **tgt start addr** address.

TPCMD READ

Command syntax:

```
TPCMD READ F <tgt start addr> <len>
```

Command parameters and options:

F: Specifies Flash (**F**) memory.



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

len: Number of locations to be verified

Description:

It reads **len** locations of Flash memory starting from the **tgt start addr** address.

TPCMD DUMP

Command syntax:

TPCMD DUMP F <dst start addr> <tgt start addr> <len>

Command parameters and options:

F: Specifies Flash (**F**) memory.

dst start addr: Destination file location from where the dump operation will store data.

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

len: Number of locations to be read and stored

Description:

This command will create a file with the memory content of the location specified starting from **tgt start addr** for a size of **len**. The parameter **dst start addr** is the starting address in the dump file.

TPCMD RUN

Command syntax:

TPCMD RUN

Command parameters:

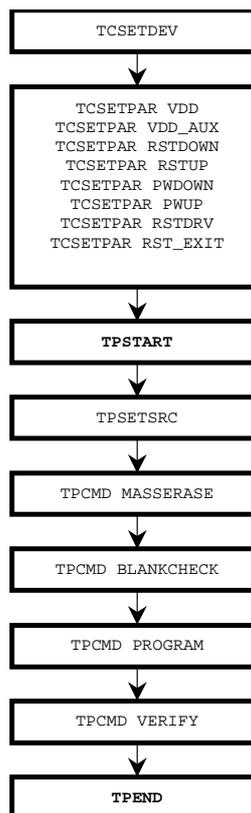
None.

Description:

It runs the target application.

4. Typical Programming Flow

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





5. Script Example

The example below shows a typical programming flow for a Maxim Teridian 71M6533H device.

```
;
; FLASHRUNNER SCRIPT EXAMPLE FOR MAXIM TERIDIAN 71M6533H
;
; Use this example as a starting point for your specific programming needs
;
; -----
;
; Hardware connections
;
; DIO0 (ICE_E)
; DIO1 (Not used)
; DIO2 (E_RXTX)
; DIO3 (E_TCLK)
; DIO4 (Not used)
; DIO5 (Not used)
; DIO6 (E_RST)

; Turns off logging
#LOG_OFF
; Halt on errors
#HALT_ON FAIL

; Sets device
TCSETDEV MAXIM 71M6533H TRDN

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

; Target voltage, mV (change as needed)
TCSETPAR VDD 3600

; VPROG1 voltage, mV (from 3000 to 14500, 0 to GND)(change as needed)
TCSETPAR VDD_AUX 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 PUSHPULL

; RESET exit mode: LOW or TRISTATE (if commented: TRISTATE)
;TCSETPAR RST_EXIT LOW

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

;-----
;Start Programming operation
;-----

; Starts programming block
TPSTART

; Mass erases Flash memory
TPCMD MASSERASE F

; Blank checks Flash memory (change address and length as needed)
TPCMD BLANKCHECK F $00000 $20000

; Programs Flash memory (change addresses and length as needed)
TPCMD PROGRAM F $00000 $00000 $20000

; Verifies Flash memory (change addresses and length as needed)
TPCMD VERIFY F $00000 $00000 $20000

; Ends programming block
TPEND
```

The FlashRunner's system software setup will install script examples specific for each device of the 71M65xx family on your PC.



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6. Programming Times

The following table shows programming times for selected Maxim Teridian 71M6533H devices.

Device	Mem. Size	Conditions	Operations	Time
Maxim Teridian 71M6533H	128KB Flash	VDD=3.6V RSTUP=21000us OPENDRAIN FR04A16	Erase + Blank Check + Program + Verify	20,80 s

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.

Maxim Teridian 71M65xx family is supported only by FR04 series and FR3070A.

7. Maxim Teridian 71M65xx specific errors



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Maxim Teridian 71M65xx-Specific Errors	
\$5300	TCSETDEV command: manufacturer not supported
\$5301	TCSETDEV command: algorithm not found on card
\$5302	TCSETDEV command: device not supported
\$5303	TCSETDEV command: load FPGA
\$5304	TCSETDEV command: internal hardware configuration error
\$5305	TCSETPAR CLKOUT command: missing parameter
\$5306	TCSETPAR CLKOUT command: invalid or out of range parameter
\$5307	TCSETPAR VDD command: invalid or out of range parameter
\$5308	TCSETPAR VDD command: missing parameter
\$5309	TCSETPAR VDD_AUX command: missing, invalid or out of range parameter
\$530A	TCSETPAR RSTUP command: invalid or out of range parameter
\$530B	TCSETPAR RSTUP command: missing parameter
\$530C	TCSETPAR RSTDOWN command: invalid or out of range parameter
\$530D	TCSETPAR RSTDOWN command: missing parameter
\$530E	TCSETPAR RSTEXIT command: missing, invalid or out of range parameter
\$530F	TCSETPAR PWDOWN command: invalid or out of range parameter
\$5310	TCSETPAR PWDOWN command: missing parameter
\$5311	TCSETPAR PWUP command: invalid or out of range parameter
\$5312	TCSETPAR PWUP command: missing parameter
\$5313	TCSETDEV command: OS version too old
\$5314	TCSETPAR command: invalid command
\$5315	TPCMD command: entry error
\$5316	TPCMD command: parameter out of range or invalid
\$5317	TPCMD MASSERASE command: invalid parameter
\$5318	TPCMD MASSERASE command: Flash masserase error
\$5319	TPCMD BLANKCHECK command: Flash blankcheck error
\$531A	TPCMD BLANKCHECK command: missing or invalid parameter
\$531B	TPCMD PROGRAM command: missing or invalid parameter
\$531C	TPCMD PROGRAM command: source offset parameter out of range
\$531D	TPCMD PROGRAM command: Flash program error
\$531E	TPCMD VERIFY command: Flash verify error
\$531F	TPCMD VERIFY command: missing or invalid parameter
\$5320	TPCMD VERIFY command: source offset parameter out of range
\$5321	TPCMD READ command: missing or invalid parameter
\$5322	TPCMD READ command: Flash read error
\$5323	TPCMD DUMP command: missing or invalid parameter
\$5324	TPCMD DUMP command: command not supported; OS version too old
\$5325	TPCMD DUMP command: missing or invalid destination parameter
\$5326	TPCMD DUMP command: Flash dump execution error
\$5327	TPCMD RUN command: run execution error
\$5328	TPSTART command: execution error
\$5329	TPEND command: execution error
\$532A	TCSETPAR RSTDRV command: missing, invalid or out of range parameter
\$532B	TPCMD Command: parameter not page aligned
\$5340	TPCMD Command: error during entry execution
\$5341	TPCMD Command: error during byte transmission The error message that follows the error code \$5341 indicates the result of the corresponding TX or RX or the logical OR of ((value_read<<8) value_expected).
\$5343	TPCMD command: error on read SFR read sequence
\$5344	TPCMD Command: error on read SFR execution
\$5345	TPCMD Command: error during byte transmission - UART protocol level
\$5346	TPCMD Command: error during byte reception - UART protocol level
\$5348	TPCMD Command: error during read call back execution
\$5349	TPCMD BLANKCHECK command: Flash not blank
\$534A	TPCMD DUMP command: write file error
\$534B	TPCMD VERIFY command: data mismatch



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\$534C	TPCMD PROGRAM	command: read source file error
\$534E	TPCMD	command: error on read SFR write sequence
\$534F	TPCMD	command: error on write SFR execution The error message that follows the error code \$534F indicates the result of the corresponding TX or RX or the logical OR of ((value_read<<8) value_expected).
\$5350	TPCMD	command: bank switching error
\$5351	TPCMD	command: write SFR error – UART protocol level
\$5352	TPCMD	command: DUT Init execution error
\$5358	TPCMD	command: the device is secured
\$5360	TPCMD MASSERASE	command: Flash masserase execution
\$5361	TPCMD	command: set bank error
\$5362	TPCMD	command: set page error
\$5366	TPCMD	command: set read dly execution error
\$5371	TPCMD	command: TX wait EOC error
\$5374	TPCMD	command: set VDD out error
\$5375	TPCMD	command: set VDD ref error
\$5376	TPCMD	command: set VDD_AUX out error
\$5377	TPCMD	command: set VDD_AUX fer error
\$5378	TPCMD	command: set VDD_AUX HiZ error
\$5379	TPCMD	command: set E_RST error
\$537A	TPCMD	command: set ICE_E error
\$537B	TPCMD	command: set E_RXTX error
\$5381	TPCMD	command: wait RX execution error
\$5382	TPCMD	command: wait EOC execution error



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8. References

FlashRunner Programmer's Manual

Microcontroller - specific datasheet

Microcontroller - Flash Programming specifications