

Interfacing FlashRunner 2.0 with AT32 devices

Protocols

SWD for all AT32 devices.

We currently support AT32 programming through SWD (Serial Wire Debug) protocol.

#TCSETPAR CMODE [SWD]

- DIO 1 - RST
- DIO 2 - SWCLK a clock driven by FlashRunner.
- DIO 5 - SWDIO a bidirectional data line.

PIN Map

SWD:

- DIO 1 - RST
- DIO 2 - SWCLK
- DIO 5 - SWDIO

Families

The AT32 family of 32-bit microcontrollers based on the Arm® Cortex®-M processor is divided into four groups and each of these groups are divided into various AT32 series:

AT32 Mainstream MCUs

- AT32F403 Series
- AT32F403A Series
- AT32F407 Series
- AT32F413 Series

AT32 Value Line MCUs

- AT32F415 Series
- AT32F421 Series
- AT32F425 Series

AT32 High Performance MCUs

- AT32F435 Series
- AT32F437 Series

Supported Families

AT32 Mainstream MCUs

- AT32F403 Series [Available in 10 days]
- AT32F403A Series [Available]
- AT32F407 Series [Available]

- **AT32F413 Series** [Available in 10 days]

AT32 Value Line MCUs

- **AT32F415 Series** [Available in 10 days]
- **AT32F421 Series** [Available in 10 days]
- **AT32F425 Series** [Available under request]

AT32 High Performance MCUs

- **AT32F435 Series** [Available under request]
- **AT32F437 Series** [Available under request]

Available Operations

AT32 Mainstream MCUs

- **AT32F403A Series**

MEMORY	MASSERASE	ERASE PAGE	BLANKCHECK	PROGRAM	VERIFY R	VERIFY S	READ	DUMP
Flash [F]	✓	✓	✓	✓	✓	✓	✓	✓
Bootloader [B]							✓	✓
Option Bytes [O]				✓	✓		✓	✓

Other commands available:

(+) Note: If RDP is set to Level 1, you cannot execute this command.

- **AT32F407 Series**

MEMORY	MASSERASE	ERASE PAGE	BLANKCHECK	PROGRAM	VERIFY R	VERIFY S	READ	DUMP
Flash [F]	✓	✓	✓	✓	✓	✓	✓	✓
Bootloader [B]							✓	✓
Option Bytes [O]				✓	✓		✓	✓

Other commands available:

- #TPCMD UNPROTECT
- #TPCMD GET_PROTECTION
- #TPCMD SET_PROTECTION [Value]
- #TPCMD CHECK_PROTECTION [Value]
- #TPCMD RESTORE_OPTION_BYTES
- #TPCMD OVERVIEW_OPTION_BYTES
- #TPCMD GET_DEVICE_INFORMATIONS (+)

- #TPCMD ERASE [Start Address] [Size]
- #TPCMD WRITE_OPTION_BYTE [Address] [Value]
- #TPCMD COMPARE_OPTION_BYTE [Address] [Value]
- #TPCMD READ_MEM8 [Address] [Byte Count]
- #TPCMD READ_MEM16 [Address] [16-bit Word Count]
- #TPCMD READ_MEM32 [Address] [32-bit Word Count]

(+) Note: If RDP is set to Level 1, you cannot execute this command.

Option Bytes

Option Bytes Organization

The Option Bytes are configured by the end user depending on the application requirements.

Option Bytes Organization case 1:

AT32F403A series, AT32F407 series.

Option Byte is written on the first eighth bits of the register and from bit 16 to bit 23.

The complementary bits are written in the remaining part of the register.

Write Option Bytes - Start

What you need to know before you can write Option Bytes:

First of all, the Option Bytes are configuration bits of the device, so pay attention to which configuration you want to set and consequently which bits you will have to set to 1 or 0 in the various Option Byte registers.

An incorrect configuration could lead to device behaviors that are not what you would expect.

In addition to this, as previously mentioned, it is advisable to know how the Option Bytes are made in memory and how they should be written.

About the Security Protection Level, you need to know that you can move from level 0 to level 1 by changing the value of the RDP byte to any value, except the value 0xCC.

When the RDP is reprogrammed to the value 0xA5 to move from Level 1 to Level 0, typically a Mass Erase of the Flash main memory is performed.

If the RDP protection level is set to 1, in some AT32 it is not possible to read the memory area where the Option Bytes are present.

What does the AT32 driver do when writing Option Bytes

The AT32 driver does not consider the complementary part of the Option Bytes as input.

For example, if we consider Option Bytes Organization case 1 and have this Option Byte as input:

0x 00 FF 5A A5

The AT32 driver will read the Option Bytes in this way:

0x 00 FF 00 A5

So, AT32 driver doesn't consider the complementary part of the Option Bytes.

This occurs for three important reasons:

- Some AT32 self-calculate the complementary part of the Option Byte when writing the same, therefore it does not make sense to read the complementary part.
- If the AT32 device does not self-calculate the complementary part, the AT32 driver will do it, therefore it is not useful again to read the complementary part.
- Based on this reading method, the user will only have to modify the "active" part of the Option Bytes without having to pay attention to calculating the complementary part.



The AT32 driver does not know the configuration you are setting on the device, and it cannot do any checks to avoid critical situations.

So please pay attention to what you are configuring via Option Bytes.

The AT32 driver checks all Option Bytes and also the complementary part of Option Bytes during a verify command.

Write, Read and Check Security Protection Level

We have implemented three commands to read, write and check the RDP value into all AT32 devices.

These three commands are:

```
#TPCMD GET_PROTECTION
```

```
#TPCMD SET_PROTECTION <Hex Value [0x00-0xFF]>
```

```
#TPCMD CHECK_PROTECTION <Integer Value [0-1]>
```

Pay attention to the fact that if the protection level is set at level 1 and you bring it to level 0, a device masserase is automatically performed.

Another feature to know is that all AT32 have the RDP value of level 0 equal to 0xA5.

This is the safest method to set the RDP if you don't know the device you are programming.

Parameters List

#TCSETPAR ENTRY_CLOCK

```
#TCSETPAR ENTRY_CLOCK
```

Default value is 4 MHz.

#TCSETPAR PLL_ENABLED

```
#TCSETPAR PLL_ENABLED
```

Default value YES.

#TCSETPAR RESET_HARDWARE

```
#TCSETPAR RESET_HARDWARE
```

Default value NO.

Accepted parameters YES / NO.

Use Hardware reset (DIO1) into Connect procedure during Halt Cortex Core.

Please leave this parameter to NO except when it is strictly necessary.

Usually the Software Reset is enough to proceed with the reset of the device and to continue with the programming procedure.

#TCSETPAR SAMPLING_POINT

```
#TCSETPAR SAMPLING_POINT
```

Default value 17.

Accepted values are in the range 1-15.

Use this parameter to permanently set the sampling point of the FPGA.

It is recommended to leave this parameter with the default value.

Commands List

#TPCMD CONNECT

#TPCMD CONNECT

|---#TPCMD CONNECT

```
|Protocol selected SWD.
|Entry Clock is 4.00 MHz.
|ID-Code read correctly at 4.00 MHz.
|Scanning AP map to find all APs.
|AP[0] IDR: 0x04770031, Type: AMBA AHB3 bus.
|Debug Port enabled.
|AP[0] ROM table base address 0xE00FF000.
|CPUID: 0x410CC601.
|Implementer Code: 0x41-[ARM].
|Found Cortex M0+ revision r0p1.
|Cortex M0+ Core halted [0.001 s].
|The device RDP's level is 0.
|PLL Enabled.
|Requested Clock is 37.50 MHz.
|Generated Clock is 37.50 MHz.
|Good samples: 6 [Range 4-9].
|IDCODE: 0x0BC11477.
|Designer: 0x23B, Part Number: 0xBC11, Version: 0x0.
|Time for Connect: 0.106 s.
```

#TPCMD MASSERASE

#TPCMD MASSERASE <Memory Type>

Masserase command isn't available for Option Bytes Area.

With this command, a Masserase of the device memory will be performed, whether this memory is made up of a single bank or two banks.

If the Security Protection Level (RDP) is set at level 1, this Masserase command will proceed by changing the protection level to level 0.

By this operation, an internal Masserase of the device will be automatically performed.

Masserase depending on the RDP value:

If RDP level is 1, erase all memory of selected type with option bytes procedure.

If RDP level is 0, erase all memory of selected type with standard procedure if available.

Available for all AT32 Devices.

#TPCMD UNPROTECT

#TPCMD UNPROTECT

Remove the Flash write protected sectors and perform a Masserase F of all Flash memory.

If there are no write protected sectors in the flash memory, then a standard Masserase F is performed.

Available for all AT32 Devices.

#TPCMD ERASE

#TPCMD ERASE <Memory Type>

Erase command isn't available for Option Bytes Area.

Erase all memory with Page/Sector erase.

With this command, a Page/Sector Erase of the device FLASH memory will be performed, whether this memory is made up of a single bank or two banks.

Typically running the Page Erase of the entire Flash memory takes much longer than running the Masserase command.

If the Security Protection Level (RDP) isn't set at level 0, an error will be returned.

Available for all AT32 Devices.

#TPCMD ERASE <Memory Type> <Start Address> <Size>

Erase selected part of memory with sector/page erase.

Erase command isn't available for Option Bytes Area.

The driver will automatically convert the value of Start Address and Size to the corresponding number of pages.

If this command is performed on a device with two FLASH memory banks but configured on a single bank, the driver automatically manages the different size of the pages.

If the Read Protection Level (RDP) is not set to level 0, an error will be returned.

Available for all AT32 Devices.

#TPCMD BLANKCHECK

#TPCMD BLANKCHECK <Memory Type>

Verify if all memory of selected type is erased.

Blankcheck command isn't available for Option Bytes Area.

If the Read Protection Level (RDP) is not set to level 0, an error will be returned.

Available for all AT32 Devices.

#TPCMD BLANKCHECK <Memory Type> <Start Address> <Size>

Verify if selected part of memory of selected type is erased.

Blankcheck command isn't available for Option Bytes Area.

If the Read Protection Level (RDP) is not set to level 0, an error will be returned.

Available for all AT32 Devices.

#TPCMD PROGRAM

#TPCMD PROGRAM <Memory Type>

Program all memory of selected type.

Available for all AT32 Devices.

#TPCMD PROGRAM <Memory Type> <Start Address> <Size>

Program selected part of memory of selected type.

Available for all AT32 Devices.

#TPCMD VERIFY

#TPCMD VERIFY <R/S> <Memory Type>

Verify all memory of selected type.

R: Readout - S: Checksum 32Bit.

Available for all AT32 Devices.

#TPCMD VERIFY <R/S> <Memory Type> <Start Address> <Size>

Verify selected part of memory of selected type.

R: Readout - S: Checksum 32Bit.

Available for all AT32 Devices.

#TPCMD READ

#TPCMD READ <Memory Type>

Read all memory of selected type.

Available for all AT32 Devices.

#TPCMD READ <Memory Type> <Start Address> <Size>

Read selected part of memory of selected type.

Available for all AT32 Devices.

#TPCMD DUMP

#TPCMD DUMP <Memory Type>

Dump all memory of selected type.

Available for all AT32 Devices.

#TPCMD DUMP <Memory Type> <Start Address> <Size>

Dump selected part of memory of selected type.

Available for all AT32 Devices.

#TPCMD RESTORE_OPTION_BYTES

#TPCMD RESTORE_OPTION_BYTES

This command is used to restore Option Bytes to a default value, when they are in a not optimal condition, due for example to an incorrect input file.

With this command, as you can guess from the name itself, it is possible to return the Option Bytes to the Default state (when this operation is possible).

The Default value of the Option Bytes is often the one present when the device leaves the factory.

More precisely, in the various Reference Manuals you can find the various default values for each AT32 family and subfamily.

Remember to use this command when you are not be able to restore manually the option bytes.

Available for all AT32 Devices.

#TPCMD OVERVIEW_OPTION_BYTES

#TPCMD OVERVIEW_OPTION_BYTES

Reads all option bytes present in the device and represents these values with various tables in the Real Time Log.

Available for all AT32 Devices.

#TPCMD GET_PROTECTION

#TPCMD GET_PROTECTION

Print into Real Time Log the current RDP protection present into target device.

Available for all AT32 Devices.

#TPCMD SET_PROTECTION

#TPCMD SET_PROTECTION <Protection>

Set inserted RDP protection level into target device.

Protection value in HEX format [0x00 - 0xFF].

The RDP level 0 is 0xA5 for all devices.

Other values set RDP to level 1.

When Level 1 is active, programming the protection option byte (RDP) to Level 0 causes the Flash memory to be mass-erased.

Available for all AT32 Devices.



#TPCMD CHECK_PROTECTION

#TPCMD CHECK_PROTECTION <Protection>

Check if current RDP protection level into device is the same as the one entered as a command parameter.

If it is different, the command returns an error.

The parameter values of this command can be 0, 1.

Available for all AT32 Devices.

#TPCMD WRITE_OPTION_BYTE

#TPCMD WRITE_OPTION_BYTE <Address> <Value>

Writes the Option Byte to the selected address (Address) with the entered value (Value).

The reserved bits of the Option Bytes are not changed.

Available for all AT32 Devices.

#TPCMD COMPARE_OPTION_BYTE

#TPCMD COMPARE_OPTION_BYTE <Address> <Value>

Compare the Option Byte at the selected address (Address) with the entered value (Value).

The reserved bits of the Option Bytes are not considered.

Available for all AT32 Devices.

#TPCMD GET_DEVICE_INFORMATION

#TPCMD GET_DEVICE_INFORMATION

Reads all information present in the device and represents these values with a table in the Real Time Log.

Available for all AT32 Devices.

#TPCMD GET_PROTECTED_SECTORS

#TPCMD GET_PROTECTED_SECTORS

Get all sectors Write-Erase Protected.

Available for all AT32 Devices.

#TPCMD READ_MEM8

#TPCMD READ_MEM8 <Address> <Byte Count>

It reads [Byte Count] bytes from the memory at the selected [Address] address and prints the data read in the Terminal and in the Real Time Log.

Available for all AT32 Devices.

#TPCMD READ_MEM16

#TPCMD READ_MEM16 <Address> <16-bit Word Count>

It reads [16-bit Word Count] 16-bit words from the memory at the selected [Address] address and prints the data read in the Terminal and in the Real Time Log.

Available for all AT32 Devices.

#TPCMD READ_MEM32

#TPCMD READ_MEM32 <Address> <32-bit Word Count>

It reads [32-bit Word Count] 32-bit words from the memory at the selected [Address] address and prints the data read in the Terminal and in the Real Time Log.

Available for all AT32 Devices.

#TPCMD RUN

#TPCMD RUN

Available for all AT32 Devices.

#TPCMD DISCONNECT

#TPCMD DISCONNECT

Disconnect function. Power off and exit.

Available for all AT32 Devices.