

### AN0075 Application Note

AT32 MCU-based development using RT-Thread Studio

### Introduction

This application note describes how to use RT-Thread Studio IDE tool for AT32 MCU-based application development.

Applicable products:

MCU series	AT32F series

# Contents

1	Intro	oduction	5
2	Env	ironment requirements	6
	2.1	RT-Thread Studio	6
	2.2	Login and register	6
	2.3	Chip support package install	7
		2.3.1 Online install	7
		2.3.2 Offline install	8
3	Proj	ject development	10
	3.1	Project creation	10
	3.2	Debug and download	13
	3.3	Precautions	14
4	Rev	ision history	16



# List of tables

Fable 1. Document revision history
------------------------------------

# List of figures

Figure 1. Register and log in	6
Figure 2. Online install chip support package	7
Figure 3. Offline install of chip support package	8
Figure 4. Select chip support package from PC	9
Figure 5. AT32 chip support package install success	9
Figure 6. Create a project	10
Figure 7. Project type selection	11
Figure 8. Project parameters configuration	12
Figure 9. Compiling	13
Figure 10. Download	13
Figure 11. Online debug	14
Figure 12. Chip erase	14
Figure 13. svd path configuration	15
Figure 14. FPU settings	15

## 1 Introduction

RT-Thread Studio is a free IDE development tool that offers a variety of component resources and easy-to-use graphical configuration, thus making application development easier and more efficient. The latest edition of RT-Thread Studio provides stronger support for AT32 MCU-based development. The subsequent sections describe how to drive AT32 MCU-based development through RT-Thread Studio tool in detail.

# 2 Environment requirements

### 2.1 RT-Thread Studio

The latest version of RT-Thread Studio is available on the official website of RT-Thread company at <a href="http://www.rt-thread.org/page/download.html#studio">http://www.rt-thread.org/page/download.html#studio</a>.

After successful download, click on the \*.exe to finish installation.

### 2.2 Login and register

After successful install, the Internet connection is needed for your first login. Then register an account and log in. After log in, the account is automatically remembered without requiring login for future operations. The third-party account is also supported for logging in (However, it is better to register an account).

文迎使用 RT-Thread Studio 〇 简体中文 ⑦ 简体中文 ⑦ 简体中文 ⑦ 荷体中文 ⑦ 荷体中文 ⑦ 荷体中文
账户登录
▲ 请输入手机号/邮箱/用户名
● 请输入密码
登录
会员注册   找回密码
第三方登录 ———
🐵 微信 🛛 QQ 🛛 🚳 微博
客服微信: iotosfans 客服邮箱: help@rt-thread.com

Figure 1. Register and log in

### 2.3 Chip support package install

The first time you log in, you'll see a welcome page. Then you can enter the RT-Thread Studio development interface. As a core component of IDE, the development interface offers a wealth of configuration options, but they are very similar to other IDE tools in terms of content and functions, except for display mode. Therefore, the users just need focus on the special features of the RT-Thread Studio. The chip support package can be installed online and offline, which are detailed in the subsequent sections.

### 2.3.1 Online install

For online install, the chip support package is downloaded automatically through SDK tool. Follow the steps below:

- 1. Click on "SDK Manager"
- 2. Select AT32 chip support package
- 3. Click on "Install Packages".

🙀 workspace - RT-Thread Studio
File Edit Source Refactor Navigate Search Project Run Window Help
Construction of the second sec

### Figure 2. Online install chip support package

Project Explorer 🛛 📄 🔩 🔻 🗖 🗖	1, click "SI	Kinger" Kinger Kinger			_		×
		File					
		Resource Library					
		Name	Size	Status	Description		,
		✓ □ □ RT-Thread Source (			RT-Thread source code releases		
		<b>4.0.2</b>	65 MB	Installed	released v4.0.2		
		🗌 🖶 nano-v3.1.3	32 MB	Installed	Nano released 3.1.3		
		🗌 # Its-v3.1.4	65 MB	Installed	LTS released v3.1.4		
		🗌 🕀 latest	561 MB	Not install	rt-thread master branch	Update	
		V Chip_Support_Pack			Device vendor Chip Support Packages		
		✓ ■					
		✓ ■  AT32F4 2, select	chip suppo	rt package"			
		✓ ⊕ 0.0.3	24 MB	Not install	released v0.0.3, Update yaml_version f		
		<u></u> ⊕ 0.0.2	24 MB	Not install	released v0.0.2		
		<b>⊕</b> 0.0.1	24 MB	Not install	released v0.0.1		
		👻 🗌 🗀 STMicroelectroni					
		✓ □ = STM32F0		_			
	1910日期 4月4	<u></u> ⊕ 0.1.9	46 MB	Not install	released v0.1.9		
		⊕ 0.1.7	46 MB	□Not install	released v0.1.7		
	Log Consol	✓ □		D			
				17			
					Install 1 packages Dele	ete packag	Je
					3、click "Install packages	"	
		Resource package deleted suce	cessfully			Show	L

In Figure 2 above, the version of the chip support package is subject to the actual situation, that is, click on the latest version.

Note: The Internet connection is required for all download and installations.

### 2.3.2 Offline install

Prior to offline installation, it is necessary to get the chip support package prepared on your PC for use. Its file name is like this: sdk-csp-at32f4.zip.

Follow the steps below to install:

- 1. Click on "SDK Manager"
- 2. Click on "File"
- 3. Click on "Import resource pack"
- 4. Click on "Browse", select an offline support package from PC
- 5. Click on "OK"

Figure 3	Offline	install	of	chip	sup	port	packad	ae
	••••••			P			P	





<ul> <li>iversity workspace - RT-Thread Studio</li> <li>File Edit Source Refactor Navi</li> <li>iversity workspace - Studies</li> <li>ivers</li></ul>	igate Search Proje	t Run Window Help □ ▼ ⇔ ▼		
🔁 Project Explorer 🛛 🕒 🕿		RT-Thread SDK Manager File Resource L Maport resource pack		×
			1、click "Browse" packages	, select chip support
			2、click "OK" OK	Cancel
	E Proble Log Con		Vot install Vot install  nstall pr	v
		Done loading pakcges.		Show Log

#### Figure 4. Select chip support package from PC

Whatever online or offline install, after successful installation, you will see that the status of chip support package is changed from "Not installed" to "Installed", as shown in Figure 5.



Figure 5. AT32 chip support package install success

After successful install, users can select and configure the corresponding AT32 MCU for a newly created project. At the same time, the low-level driver files related to AT32 MCU are also ported into the new project. The driver files imported depend on the type of project (bare-board project, Nano project, RT-Thread Studio project)



### **3 Project development**

When it comes to AT32 MCU-based project development using RT-Thread Studio, the main focus is on project creation as the users need select a manufacturer, product series and part number pertaining to a microcontroller, as well as functional parameters such as console serial port, pins and adapter.

### 3.1 **Project creation**

Enter the RT-Thread Studio main interface, and follow the steps below to create a project:

- 1. Click on "File"
- 2. Click on "New"

Г

3. Select "Project ... ""

New Open File Recent Files	Alt+Shift+N >	Bare-Board Project     RT-Thread Project     Project	
Close Close All Save Save As Save All Revert	Ctrl+W Ctrl+Shift+W Ctrl+S Ctrl+S Ctrl+Shift+S	<ul> <li>Convert to a C/C++ Project (Adds C/C++ Nature)</li> <li>Source Folder</li> <li>Folder</li> <li>Source File</li> <li>Header File</li> <li>File from Template</li> <li>Class</li> </ul>	
Move Rename Refresh Convert Line Delimiters To	F2 F5 >	3 Other Cti	rl+N
Print Import Export Properties	Alt+Enter		
Switch Workspace Restart Exit	>	◎ 任务 📮 Console 🛛 □属性 🖋 Search Isole	

#### Figure 6. Create a project



After above operations, you will see three options available for your selection, as shown in Figure 7.

- 1. Bare-Board Project
- 2. RT-Thread Nano Project
- 3. RT-Thread Project

Figure	7.	Pro	iect	type	selecti	ion
inguic	•••		1000	U P C	301000	<b>U</b> 11

New Project				
Select a wizard Create a new Bare-	Board project			
Wizards:				
type filter text				
<ul> <li>Bare-Board Pr</li> <li>RT-Thread Na</li> <li>RT-Thread Pro</li> </ul>	oject no Project oject			
0	< Back	Next >	Finish	Cancel

As the procedures of project creation are generally similar for these three projects, we take the "RT-Thread Project" as an example of demonstrating how to create a project.

After selecting "RT-Thread Project", click on "Next>", a dialogue window is displayed below:



Project name must	be specified						
i roject name must	be specified						
Project name:							
✓ Use default loca	tion						
Location: C:\RT-Thr	eadStudio\wor	kspace				Brow	se
● Base On MCU	O Base On BS	SP					
RT-Thread : 4	4.0.2						<b>**</b>
Vendor :	ArteryTek		~	Series :	AT32F4		~
Subseries : A	AT32F403A		$\sim$	MCU :	AT32F403ACC	CT7	~
Console UART :	JART1 ~	TXP: PA9		RXP :	PA10		
Adapter : J	-Link ~	Port: SWD					<b>1</b>
Suggestions after r	ncu based proj	ect created:					
The chip use an int	ernal HSI clock.	If you need to	o modify	y it, pleas	e check and mo	odify drv	_clk.c

Figure 8. Project parameters configuration

This window deals with parameters configuration, including project name, storage location, RT-Thread version and MCU-related information.

After a successful installation of AT32 chip support package, the users can select a desired MCU part number here.

In "Vendor" option, select "ArteryTek" on the drop-down menu.

In "Series" option, select "AT32F4" on the drop-down menu.

In "Subseries" option, currently, only AT32F403A and AT32F407 are supported, and more products will be added later (depending on the AT32 chip support package installed).

In "MCU" option, select a specific part number according to the needs

In "Console UART" option, select a console serial port and TX/RX pins

In "Adapter" option, select a debugger and J-Link/DAP-LINK

In "Port" option, select a debug interface (JTAG or SWD). The SWD port is recommended as it is a default interface of AT-LINK on our AT-START evaluation board.

Finally, click on "Next>" or "Finish", a project is generated.



### 3.2 Debug and download

After creating a project, follow the steps below to compile.

- 1. Click and select the new created project name.
- 2. Click on "Compile" icon
- 3. View output information

Figure	9.	Compiling
--------	----	-----------

Event				
Elle Sturder Orkingene Search Errojett Bun Window Help         Image: Search S	🚔 workspace - RT-Thread Studio		- 0	$\times$
Console II * Search * Debug         Console II * Search * Debug         De Titoring h	Eile Edit Source Refactor Navigate Search Project Run Window Help			
● Project Explorer ::       ● % * ● ●         ● Ext   Active - Debug]       ●         ● Rinkrids Settings       ● applications         ● Debug       ● others         ● Understeine       ● inhorates         ● inhorates		*	Quick Access 😰 🗟 🕻	★调试
Ext [Active - Debug]     Elimine's     Elimine's	Project Explorer #			• •
© Console II ≠ Search ★ Debug CDT Build Console [test] Used Size(B) Used Size(KB) Flash: 51220 B 50.02 KB 13:27:48 Build Finished. 0 errors, 0 warnings. (took 5s.155ms) ③	<pre>( Stef [Active - Debug]</pre>			
© test	© Console № // Search ▲ Debug CDT Build Console [test] Used Size(B Flash: 51220 B RAM: 4152 B 13:27:48 Build Finished.	Used Size(KB) 50.02 KB 4.05 KB 4.05 K 9 errors, 0 warnings. (took 5s.155ms)		^
(a) → V → V → V → V → V → V → V → V → V →				
	(3)			>
	l⊠ test			-

After successful compiling, it is ready to download and debug. In "Flash Download" icon, select an adapter (J-LINK or DAP-LINK). If you need to use AT-LINK on the AT-START evaluation board for downloading, please tick "DAP-LINK" here. Then click on "Flash Download" icon.

#### Figure 10. Download



To perform online Debug, click on "Debug Launch" icon to start downloading and debugging. Online debugging can be done in "step into" or "go" mode. The real-time register information is shown in the right side of the figure below.

Figure	11.	Online	debug
--------	-----	--------	-------

3 • 🗟 🖏   🗞   🛛   🕨 🛯 🖉   🖉   🖓   🖓 👘 🗮 🛫 🕄	2 . 2			Quick Access 邮 唱 C 含调量			
Debug 🗉 👘 👘 🖻	🖻 m Debug launch		Disassembly & Periphe	erals 🕮 👘 🖻 🖉 🖤 🕫			
<ul> <li>test.DAPLink.Debug [GD8 PyOCD Debuç</li> <li>tithread.eff</li> <li>main() at main.c19 0x8009452</li> <li>pyocd.exe</li> <li>arm-none-eabi-gdb.exe</li> </ul>	<pre>13 #define DBG_TAG "main" 14 #define DBG_LVL DBG_LOG 15 #include <rtdbg.h> 16 17*int main(void) 18 { 19 int count = 1; 20 while (count++) 22 { 23 LOG_D("Hello RT-Thread!"); 24 rt_thread_mdelay(1000); 25 } 26 27 return RT_EOK; 28 } 29</rtdbg.h></pre>	^	Peripheral         Addres	s Description Analog to digital com Analog to digital com Analog to digital com Analog to digital com Analog to digital com Atternate function I/O Comtroller area netwo Controller area netwo Controller area netwo Digital to analog com DMA controller DMA controller			
	🛡 Console 🗉 🖺 问题 📀 Executables 🗟 Debugger Console 🛛 Memory 🧏 📓 🖃 💌 🔍 🔹 🗇						
	GNU MCU Eclipse Packs console						
	2020-10-13 13:45:03 Parsing SVD file "C:\RT-ThreadStudio\repo\Extract\Chip_Support_Packages\Arte Completed in 99ms.	ryTek\AT32F4	\0.0.4\debug\svd\AT32	F403Axx.svd"			

### 3.3 Precautions

There are several aspects worth of attention when using RT-Thread Studio.

- 1. A chip support package must be installed before starting AT32 MCU-based development
- 2. Internet connection is required for development through tool kits.
- 3. When the "DAP-LINK" mode is used for downloading, it may cause errors due to mismatch issue. In this case, perform "Chip erase" operation.



🖻 🔻 🔛 🕼   🗞 🔻 🕭 🚫 💷	***	🔄 🌺 The configuration of Project — 🗆 🗙
Project Explorer ≅ >		Configure project build, link, debug, download parameters
		Project configuration name: test.DAPLinkEligkug <sup>"Download"</sup>
		🗈 Main 🌣 Debugger 🕨 Startup 🕭 Download 🦻 Source 🗔 Common 🗟 SVD Path
		Erase the Settings
		Flash mode: Auto 3, Select "Chip erase"
		Programming Chip erase
		Is Boot Sector erase is Range File Path
		Add Remove
	🗈 Prot	plems



4. For the chip support package installed offline, due to IDE itself, it may cause peripheral registers window to be unable to display during online debugging. In this case, replace "Extract" with "Local", as shown below.

	The configuration of Project - C
△ Project Explorer ≅	Configure project build, link, debug, download parameters
	Project configuration name: test.DAPLink.Debug 2、click *SVD Path*
	🖹 Main 🇇 Debugger 🕨 Startup 🕭 Download 🦻 Source 🗉 Common 🗟 SVD Path
	SVD file (used by the peripheral registers viewer)
	File path:         \${studio_install_path}repo         Extract         Chip_Support_Packages         ArteryTel         Browse         Variables
	3、 "Local" replace"Extract"
	Problems
E: F	

Figure 13. svd path configuration

5. If the FPU is not supported by hardware of a certain MCU, for example, AT32F415, disable FPU option, and use soft floating mode to compile, so as to prevent C library or other errors, as shown below.

Figure 14. FPU settings

File Edit Source Refactor Navigate Sear	type filter text	Settings			$\diamond \bullet \diamond \bullet$
Project Explorer 1, click *setting Dialog → etest	<ul> <li>Resource</li> <li>C/C++ Build</li> <li>Build Variable</li> <li>Environment</li> <li>Logging</li> <li>Settings</li> </ul>	Configuration: Debug [Active]	😤 Build Artifact 🗟 B	Manage Confi inary Parsers     e Error Parsers	gurations
	Tool Chain Eta > C/C++ General > MCU Project Natures Project Referenc Run/Debug Sett	<ul> <li>arget Processor</li> <li>Optimization</li> <li>Warnings</li> <li>Debugging</li> <li>Includes</li> <li>Preprocessor</li> <li>Includes</li> <li>Warnings</li> <li>Miscellaneous</li> <li>Includes</li> <li>Optimization</li> <li>Warnings</li> <li>Miscellaneous</li> <li>Includes</li> <li>Optimization</li> <li>Warnings</li> <li>Miscellaneous</li> <li>Includer</li> </ul>	ARM family Architecture Instruction set Thumb interwo Endianness Float ABI FPU Type Unaligned access AArch64 family Feature crc Feature crypto Feature fp	cortex-m4 Toolchain default Thumb (-mthumb) rk (-mthumb-interwork) Toolchain default Library (soft) Ubrary (soft) Ubrary (soft) Ubrary (soft) Toolchain default Toolchain default Toolchain default Toolchain default	<ul> <li>✓</li> <li>✓</li></ul>
	٢ )	<ul> <li>@ General</li> <li>@ Libraries</li> <li>@ Miscellaneous</li> <li>&gt; @ GNU ARM Cross Create Flash Image</li> <li>@ General</li> <li>&gt; @ GNU ARM Cross Print Size</li> <li>@ General</li> </ul>	Feature simd Code model Strict align (-ms Other target flags	Enabled (+simd) Small (-mcmodel=small) strict-align)	~



# 4 Revision history

Table 1. Document	revision	history
-------------------	----------	---------

Date	Revision	Changes
2022.04.25	2.0.0	Initial release

#### IMPORTANT NOTICE - PLEASE READ CAREFULLY

Purchasers are solely responsible for the selection and use of ARTERY's products and services; ARTERY assumes no liability for purchasers' selection or use of the products and the relevant services.

No license, express or implied, to any intellectual property right is granted by ARTERY herein regardless of the existence of any previous representation in any forms. If any part of this document involves third party's products or services, it does NOT imply that ARTERY authorizes the use of the third party's products or services, or permits any of the intellectual property, or guarantees any uses of the third party's products or services or intellectual property in any way.

Except as provided in ARTERY's terms and conditions of sale for such products, ARTERY disclaims any express or implied warranty, relating to use and/or sale of the products, including but not restricted to liability or warranties relating to merchantability, fitness for a particular purpose (based on the corresponding legal situation in any unjudicial districts), or infringement of any patent, copyright, or other intellectual property right.

ARTERY's products are not designed for the following purposes, and thus not intended for the following uses: (A) Applications that have specific requirements on safety, for example: life-support applications, active implant devices, or systems that have specific requirements on product function safety; (B) Aviation applications; (C) Aerospace applications or environment; (D) Weapons, and/or (E) Other applications that may cause injuries, deaths or property damages. Since ARTERY products are not intended for the above-mentioned purposes, if purchasers apply ARTERY products to these purposes, purchasers are solely responsible for any consequences or risks caused, even if any written notice is sent to ARTERY by purchasers; in addition, purchasers are solely responsible for the compliance with all statutory and regulatory requirements regarding these uses.

Any inconsistency of the sold ARTERY products with the statement and/or technical features specification described in this document will immediately cause the invalidity of any warranty granted by ARTERY products or services stated in this document by ARTERY, and ARTERY disclaims any responsibility in any form.

© 2022 Artery Technology -All rights reserved