Application Note

Document No.: AN1157

APM32F4xx_SDK Quick Start Guide

Version: V1.0

1. Introduction

The APM32F4xx SDK (Software Development Kit) is a comprehensive set of development drivers and documentation specifically designed for the APM32F4xx series of MCUS. It includes standard peripheral driver libraries, a series of routines provided for different development boards, and rich middleware. It aims to significantly enhance the productivity of developers by reducing the workload, time and cost of development.

The information involved in this application note

AN1080_APM32 Series Tool Chain User Manual

AN1081_APM32F4xx_Quick Start Guide

AN1085_APM32F4xx_Download Application Note

AN1086_APM32F4xx_ISP Application Note

AN1093_APM32_Eclipse Development Tutorial under APM32 Arm MCU Windows System

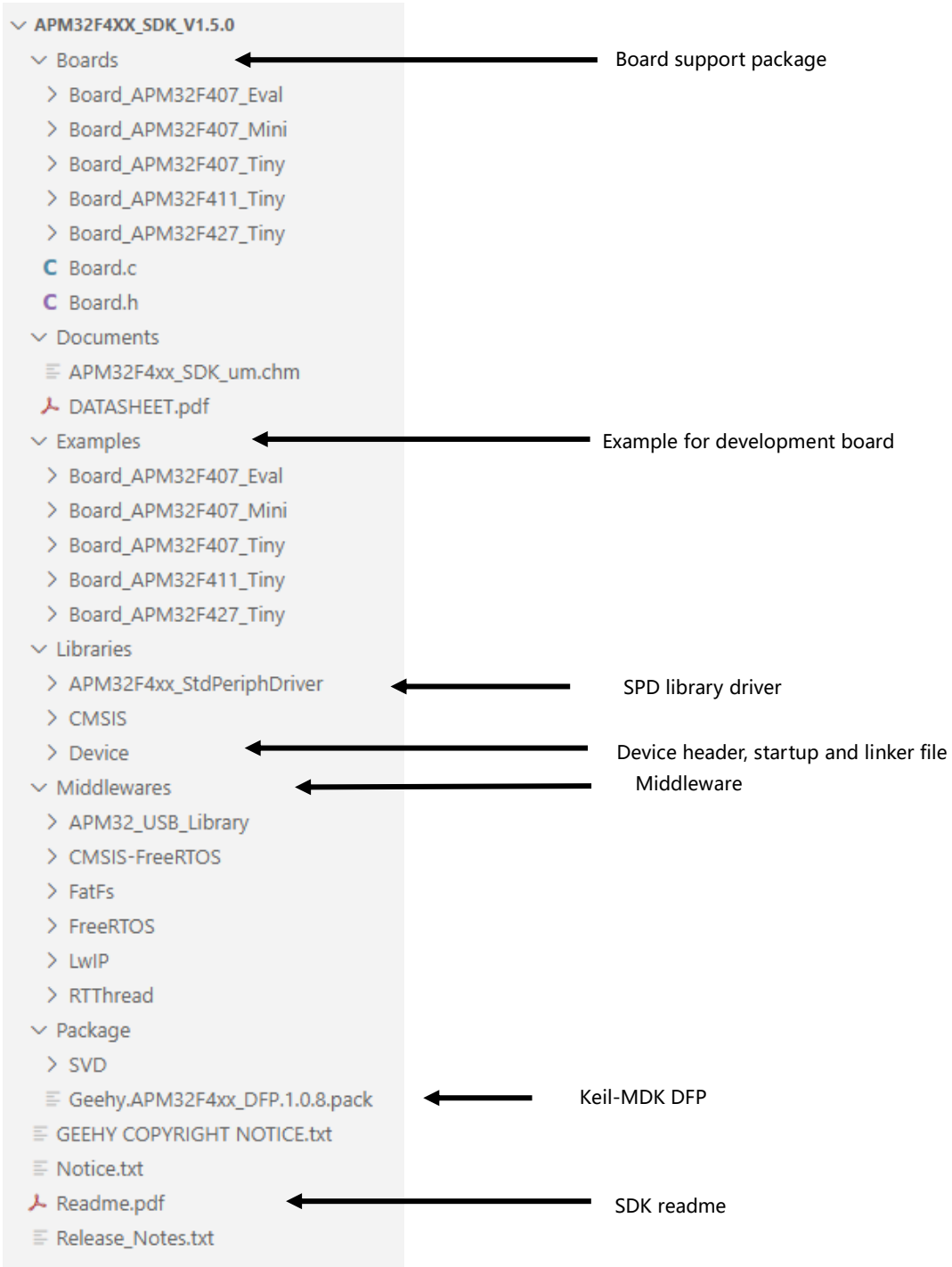
All are available at www.geehy.com.

目录

2. Regarding the SDK content

The complete SDK content is as follows

Figure 1 SDK content



3. Regarding the Boards content

The Boards file contains the BSP support package for the APM32F4xx development board. It can help quickly drive the peripheral circuits or components on the board card. BSP can be found in the ~ /Boards directory.

The provided BSP is built for the APM32F4xx motherboard. For the use of boards developed by other users, some minor modifications may be required.

The directory structure of Boards is as follows:

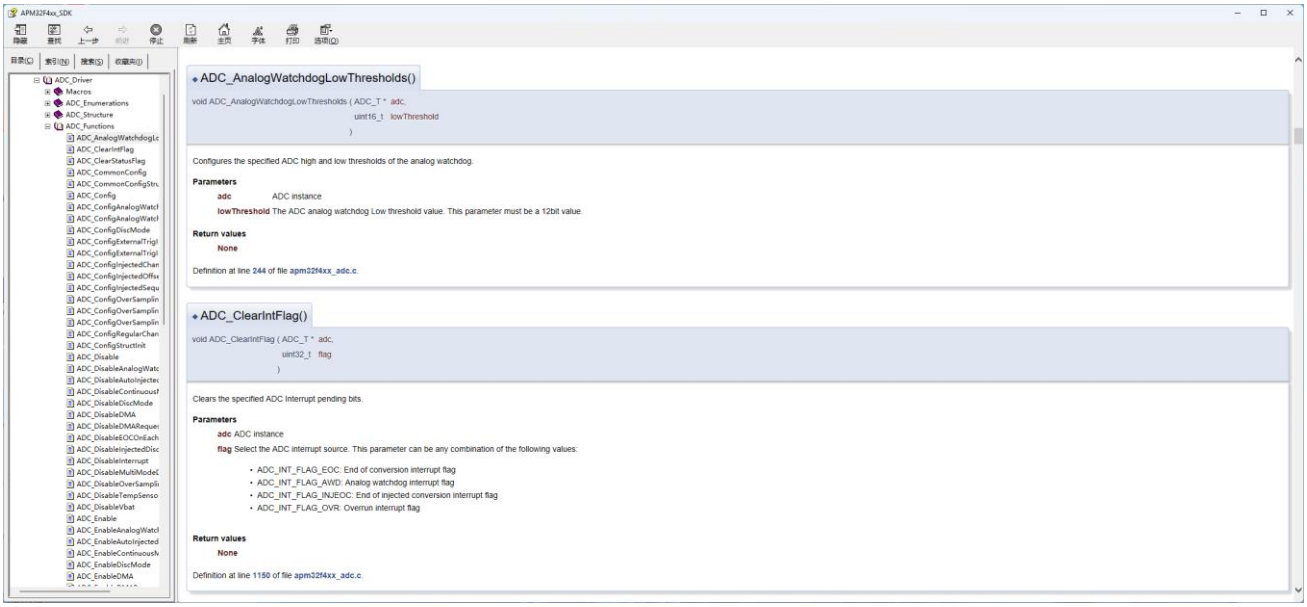
- Board.c
- Board.h
- Board_APM32F407_Eval file
- Board_APM32F407_Mini file
- Board_APM32F407_Tiny file
- Board_APM32F411_Tiny file
- Board_APM32F427_Tiny file

4. Regarding the Documents content

The Documents file contains a linked file that can be redirected to the technical support center of Geehy Semiconductor. Library support documentation can be found in the ~ /Documents directory, where you can view all supported function explanations, parameter roles, and return values.

- DATASHEET.pdf
- APM32F407xx_um.chm
- APM32F411xx_um.chm
- APM32F427xx_um.chm

Figure 2 Library documentation



5. Regarding the Examples content

Sample applications can be found in the ~ /Examples directory.

The provided example is built for the APM32F4xx xxx development board. Some minor modifications may be needed for the use of other users' development boards.

The directory structure of the routine project is as follows:

- Example file
  - Include
  - Project
    - Eclipse
    - IAR
    - MDK
  - Source

All sample applications were tested using **APM32F4xx StdPeriphDriver V1.0.4**, including the following examples:

Table 1 List of sample programs supported by the development board

IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
ADC	ADC_AnalogWindowWatchdog	√	√		√	√				
	ADC_ContinuousConversion	√	√		√	√				
	ADC_DualInterleavedMode	√	√			√				
	ADC_DualRegulSimulMode	√	√			√				
	ADC_MultiChannelScan	√	√		√	√				
	ADC_Tsensor	√	√		√	√				
	ADC_TripleInterleavedMode	√	√			√				
	ADC_DMA	√	√		√	√				
	ADC_VBAT	√	√		√	√				
	ADC_ContinuousConversionADC2				√					
CAN	CAN_LoopBack	√	√	√	√	√				

IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
	CAN_Normal	√	√	√	√	√				
CRC	CRC_Calculation	√	√		√	√				
COMP	COMP_PWMBreak				√					
	COMP_WindowComparator				√					
CRYP	CRYP_AES	√								
	CRYP_DES-TDES	√								
DAC	DAC_ADC	√	√			√				
DCI	DCI_OV2640	√		√						
DMC	DMC_SDRAM			√						
DMA	DMA_ADC	√	√			√				
	DMA_FIFOMode	√	√		√					
	DMA_FMCToRAM	√	√		√	√				
DSP	DSP_bayes	√								
	DSP_class_marks	√								
	DSP_convolution	√								
	DSP_dotproduct	√								
	DSP_fft_bin	√								
	DSP_fir	√								
	DSP_graphic_equalizer	√								
	DSP_linear_interp	√								
	DSP_matrix	√								
	DSP_signal_converge	√								
	DSP_sin_cos	√								
	DSP_svm	√								
	DSP_Template	√								
	DSP_variance	√								
EINT	EINT_Config	√	√		√	√				
ETH	ETH_Ping		√	√		√				

IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
	ETH_TCP_client		√	√		√				
	ETH_TCP_server		√	√		√				
FMC	Flash_Emulation_Eeprom	√	√							
	FMC_Write	√	√		√	√				
GPIO	GPIO_Toggle	√	√		√	√				
HASH	HASH_SHA1	√								
I2C	I2C_TwoBoards_Master	√	√		√					
	I2C_TwoBoards_Slave	√	√		√					
	I2C_TwoBoardsPolling					√				
	I2C_EEPROM		√							
IAP	Application1	√	√		√	√				
	Application2	√	√		√	√				
	Bootloader	√	√		√	√				
I2S	I2S_Interrupt	√	√		√					
IWDT	IWDT_Reset	√	√		√	√				
NVIC	NVIC_Priority	√	√		√	√				
	NVIC_WFI	√	√		√	√				
LCD	LCD_ShowFigure			√						
	LCD_TOUCH			√						
PMU	PMU_BOR	√	√			√				
	PMU_Consumption	√	√		√	√				
	PMU_PVD	√	√			√				
	PMU_STANDBY	√	√		√	√				
	PMU_STOP	√	√		√	√				
QSPI	QSPI_ReadWrite				√	√				
	QSPI_ReadWriteDMA				√	√				
	QSPI_ReadWriteInterrupt				√	√				
RCM	RCM_ClockConfig	√	√		√	√				

IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
RNG	RNG_MultiRNG	√	√		√	√				
RTC	RTC_Alarm	√	√	√	√	√				
	RTC_Calendar			√						
RTOS	FreeRTOS	√			√					
	RT-thread	√	√		√					
	CMSIS_FreeRTOS		√			√				
	CMSIS_RTX		√			√				
SDIO	SDIO_SDCard	√		√	√	√				
SPI	SPI_FullDuplex	√	√	√	√	√				
	SPI_Flash			√						
Template	Template	√	√	√	√	√				
TMR	TMR_6Steps	√	√		√	√				
	TMR_32BitCount	√	√			√				
	TMR_CascadeSynchro	√	√		√	√				
	TMR_EncoderInterface	√	√		√	√				
	TMR_ExtTriggerSynchro	√	√		√	√				
	TMR_InputCapture	√	√		√	√				
	TMR_OCActive	√	√		√	√				
	TMR_OCInactive	√	√		√	√				
	TMR_OCToggle	√	√		√	√				
	TMR_ParallelSynchro	√	√		√	√				
	TMR_PWMInput	√	√		√	√				
	TMR_PWMOutput	√	√		√	√				
	TMR_SinglePulse	√	√		√	√				
	TMR_TimeBase	√	√		√	√				
	TMR_TMR1DMABurst	√	√		√	√				
	TMR_TMR1PWMOutput	√	√		√	√				
	TMR_TMR1Synchro	√	√		√	√				

IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
	TMR_TMR2PWMOutput	√	√		√	√				
	TMR_TMR8DMA	√	√		√	√				
	TMR_TMR9OCToggle	√	√			√				
	TMR_TMR11PWMOutput	√	√			√				
USART	USART_IrDA	√				√				
	USART_LIN	√				√				
	USART_Printf	√				√				
	USART_Smartcard	√				√				
	USART_TwoBoardsDMA	√	√		√	√				
	USART_TwoBoardsInterrupt	√	√		√	√				
	USART_TwoBoardsPolling	√	√		√	√				
	USART_Interrupt			√						
	USART_Polling			√						
	USART_RS485			√						
OTG FS	OTGD_CDC	√		√	√	√				
	OTGD_Custom_HID	√			√	√				
	OTGD_Custom_HID_Keyboard	√		√	√	√				
	OTGD_HID	√		√	√	√				
	OTGD_HID_Keyboard	√		√	√	√				
	OTGD_HID_WakeUp_LowPower	√			√	√				
	OTGD_MSC	√		√	√	√				
	OTGD_MSC_LowPower	√			√	√				
	OTGD_MSC_NorFlash			√						
	OTGD_MSC_SDCard			√						
	OTGD_WINUSB	√		√	√	√				
	OTGD_Composite_CDC	√			√	√				
	OTGD_Composite_CDC_HID	√			√	√				
	OTGD_Composite_CDC_MSC	√			√	√				

IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
	OTGD_Composite_CDC_WINUSB	√			√	√				
	OTGD_Composite_HID_MSC	√			√	√				
	OTGD_Composite_HID_WINUSB	√			√	√				
	OTGD_Composite_MSC_WINUSB	√			√	√				
	OTGD_Composite_WINUSB	√			√	√				
	OTGH_CDC	√			√	√				
	OTGH_DynamicSwitch	√			√	√				
	OTGH_HID	√			√	√				
	OTGH_MSC	√			√	√				
	OTGH_MSC_FWUpgrade	√			√	√				
OTG FS2	OTGD_CDC_FS2					√				
	OTGD_HID_WakeUp_LowPower_FS2					√				
	OTGH_CDC_FS2					√				
OTG HS1	OTGD_MSC_HS1	√								
	OTGD_MSC_HS_IN_FS		√							
	OTGH_HID_HS1	√								
OTG HS2	OTGD_MSC_NorFlash_HS2			√						
	OTGD_MSC_SDCard_HS2			√						
	OTGD_CDC_HS2		√							
	OTGD_Composite_CDC_HID_HS2		√							
	OTGD_Composite_CDC_HS2		√							
	OTGD_Composite_CDC_MSC_HS2		√							
	OTGD_Composite_CDC_WINUSB_HS2		√							
	OTGD_Composite_HID_MSC_HS2		√							
	OTGD_Composite_HID_WINUSB_HS2		√							
	OTGD_Composite_MSC_WINUSB_HS2		√							
	OTGD_Composite_WINUSB_HS2		√							
	OTGD_Custom_HID_Keyboard_HS2		√							

IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
	OTGD_HID_HS2		√							
	OTGD_HID_LowPower_HS2		√							
	OTGD_MSC_HS2		√							
	OTGD_WINUSB_HS2		√							
	OTGH_CDC_HS2		√	√						
	OTGH_HID_HS2		√	√						
	OTGH_MSC_HS2		√	√						
DRD	DRD_MSC_CDC_DualCore			√						
Dual Core	MSC_CDC_DualCore			√						
	OTGD_CDC_DualCore			√						
WWDT	WWDT_OverTime	√	√		√	√				

6. Regarding the Libraries content

The Libraries file contains a series of library files. It can provide support for the APM32F4xx MCU, such as device support, startup files, link files and standard peripheral support, etc. Library files can be found in the ~ /Libraries directory.

The APM32F4xx MCU includes the following libraries:

- Libraries file
  - APM32F4xx_StdPeriphDriver
  - CMSIS
  - Device

6.1. APM32F4xx_StdPeriphDriver

This file contains all the standard peripheral library driver files.

Table 2 List of SPD drivers supported by the device

IP / Module	APM32F405xx	APM32F407xx	APM32F415xx	APM32F417xx	APM32F411xx	APM32F425xx	APM32F427xx	NA	NA	NA
apm32f4xx_adc.c	√	√	√	√	√	√	√			
apm32f4xx_can.c	√	√	√	√	√	√	√			
apm32f4xx_comp.c					√					
apm32f4xx_crc.c	√	√	√	√	√	√	√			
apm32f4xx_cryp.c			√	√						
apm32f4xx_cryp_aes.c			√	√						
apm32f4xx_cryp_des.c			√	√						
apm32f4xx_cryp_tdes.c			√	√						
apm32f4xx_dac.c	√	√	√	√		√	√			
apm32f4xx_dbgmcu.c	√	√	√	√	√	√	√			
apm32f4xx_dci.c		√		√						
apm32f4xx_dma.c	√	√	√	√	√	√	√			
apm32f4xx_dmc.c		√		√		√	√			
apm32f4xx_eint.c	√	√	√	√	√	√	√			
apm32f4xx_eth.c		√		√		√	√			
apm32f4xx_fmc.c	√	√	√	√	√	√	√			
apm32f4xx_gpio.c	√	√	√	√	√	√	√			
apm32f4xx_hash.c			√	√						
apm32f4xx_hash_md5.c			√	√						

IP / Module	APM32F405xx	APM32F407xx	APM32F415xx	APM32F417xx	APM32F411xx	APM32F425xx	APM32F427xx	NA	NA	NA
apm32f4xx_hash_sha1.c			√	√						
apm32f4xx_i2c.c	√	√	√	√	√	√	√			
apm32f4xx_iwdt.c	√	√	√	√	√	√	√			
apm32f4xx_misc.c	√	√	√	√	√	√	√			
apm32f4xx_pmu.c	√	√	√	√	√	√	√			
apm32f4xx_qspi.c					√	√	√			
apm32f4xx_rcm.c	√	√	√	√	√	√	√			
apm32f4xx_rng.c	√	√	√	√	√	√	√			
apm32f4xx_rtc.c	√	√	√	√	√	√	√			
apm32f4xx_sdio.c	√	√	√	√	√	√	√			
apm32f4xx_smc.c	√	√	√	√	√	√	√			
apm32f4xx_spi.c	√	√	√	√	√	√	√			
apm32f4xx_syscfg.c	√	√	√	√	√	√	√			
apm32f4xx_tmr.c	√	√	√	√	√	√	√			
apm32f4xx_usart.c	√	√	√	√	√	√	√			
apm32f4xx_usb.c	√	√	√	√	√	√	√			
apm32f4xx_usb_device.c	√	√	√	√	√	√	√			
apm32f4xx_usb_host.c	√	√	√	√	√	√	√			
apm32f4xx_wwdt.c	√	√	√	√	√	√	√			

6.2. CMSIS

This file contains header files related to the Arm® Cortex®-M4F core, which define the core's registers and functions.

6.3. Device

This file contains files specifically related to the APM32F4xx device. Among them:

- The Geehy\APM32F4xx\Include file contains all the APM32F4xx device header files, which define the device's registers and interrupt vectors.
- The Geehy\APM32F4xx\Source file contains startup files and link files for the MDK, IAR, and GCC platforms, including the reset vector table and startup code.

7. Regarding the Middlewares content

The Middlewares file contains a series of third-party middleware. These middleware can be found in the ~ /Middlewares directory.

APM32F4xx using middleware include:

- Middlewares file
  - APM32_USB_Library
  - FatFs
  - CMSIS-FreeRTOS
  - FreeRTOS
  - LwIP
  - RTThread

7.1. APM32_USB_Library

The APM32_USB_Library file contains the APM32 USB Device Library and the APM32 USB Host Library, and is applicable to all APM32 MCUs with USB peripherals.

7.2. FatFs

The FatFs file contains the FatFs file system and a series of template files such as sd, sdram, sram, and usbh.

7.3. CMSIS-FreeRTOS

The CMSis-Freertos file contains the FreeRTOS operating system of the CMSIS RTOS2 standard.

7.4. FreeRTOS

The FreeRTOS file contains the native FreeRTOS operating system.

7.5. LwIP

The LwIP file contains the LwIP network protocol stack.

7.6. RT Thread

The RT Thread file contains the RT Thread Nano operating system.

8. Regarding the Package content

The Package file includes the Geehy APM32F4xx DFP Package. This Package can be found in the ~ /Package directory.

- Package file
  - SVD
  - Geehy.APM32F4xx_DFP.x.y.z.pack

8.1. SVD

This file contains SVD files for users to simulate and view registers.

8.2. Pack package

The Keil pack package stored in this file is the latest version of this version, which is used by users in the MDK-ARM environment to support the APM32F4xx series chips. The latest version of the Keil pack can also be obtained from the following address:
https://www.keil.arm.com/packs/

9. Quick Start

For a quick assessment of the APM32F4xx SDK, you may need to prepare the following environment or content:

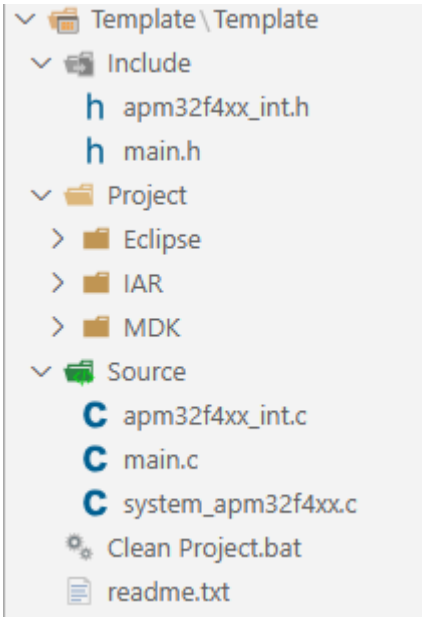
- Window 10/11
- MDK-ARM v5.40 or higher version
- IAR EW for ARM 8.50.5 or higher version
- Eclipse 4.24 or higher version
- arm-gnu-toolchain 10.3.1 or higher version
- Simulation debuggers (such as Geehy-Link or J-Link)
- Any of the following development boards (depending on the chip of the project being developed):
  - APM32F402 Tiny development board
  - APM32F403 Tiny development board
  - APM32F407 Eval development board
  - APM32F407 Mini development board
  - APM32F407 Tiny development board
  - APM32F411 Tiny development board
  - APM32F465 Mini development board
  - APM32F427 Tiny development board

The following content takes the APM32F427 Tiny development board as an example.

9.1. Template Engineering

The Template project is stored in APM32F4xx_SDK_V1.x.x/Examples/Board_APM32F427_Tiny/Template, and its content is shown in Figure 3. Template engineering including MDK, IAR and Eclipse. The "Include" and "Source" files respectively store the header files and source files used in the application code of the template project.

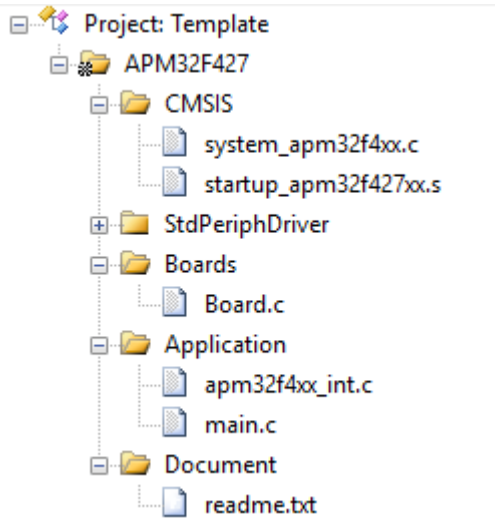
Figure 3 Template file content



Open the file of the corresponding project and click on the project file to open the corresponding IDE project. As shown in Figure 4, it is the MDK template project. The content description of the documents in the project is as follows:

1. system_apm32f4xx.c system initialization configuration file.
2. startup_apm32f427xx.s startup file.
3. The apm32f4xx_ppp.c file in the StdPeriphDriver folder is the driver file for each peripheral.
4. Board.c on-board support file.
5. The apm32f4xx_int.c interrupt file contains kernel and peripheral interrupt service functions。
6. The main code file of the main.c template project.
7. The description file of the readme.txt project.

Figure 4 MDK template engineering



9.2. SDK Related Macro Definition

When creating a new project, in addition to importing the startup file (startup_apm32f427xx.s) into the project, it is also necessary to enable the relevant macro definitions based on the MCU model. The macro definition relationships used in the SDK are shown in the following table.

Table 3 Macro Definition relational tables

Macro Definition	describe	remark
APM32F405xx	Enable support for the APM32F405RG, APM32F405VG and APM32F405ZG models	
APM32F407xx	Enable support for the APM32F407VG, APM32F407VE, APM32F407ZG, APM32F407ZE, APM32F407IG and APM32F407IE models	
APM32F415xx	Enable support for the APM32F415VG, APM32F415VE, APM32F415ZG, APM32F415ZE, APM32F415IG and APM32F415IE models	
APM32F417xx	Enable support for the APM32F417VG, APM32F417VE, APM32F417ZG, APM32F417ZE, APM32F417IG and APM32F417IE models	
APM32F411xx	Enable support for the APM32F411CC, APM32F411CE, APM32F411RC, APM32F411RE, APM32F411VC and APM32F411VE models	
APM32F425xx	Enable support for the APM32F425ZG, APM32F425VG, APM32F425RG and APM32F425CG models	
APM32F427xx	Enable support for APM32F427ZG, APM32F427VG, APM32F427RG and APM32F427CG	
APM32F407_MINI	Enable BSP support for the APM32F407 mini development board	

APM32F407_EVAL	Enable BSP support for the apm32f407 eval development board	
APM32F407_TINY	Enable BSP support for the apm32f407 tiny development board	
APM32F411_TINY	Enable BSP support for the apm32f411 tiny development board	
APM32F427_TINY	Enable BSP support for the apm32f427 tiny development board	
HSE_VALUE	Define the external high-speed clock frequency value	

9.3. Compilation and Download

The installation and usage of the IDE and simulation download toolchain can be referred to the following documents:

AN1080_APM32 Series Tool Chain User Manual

AN1081_APM32F4xx_Quick Start Guide

AN1085_APM32F4xx_Download Application Note

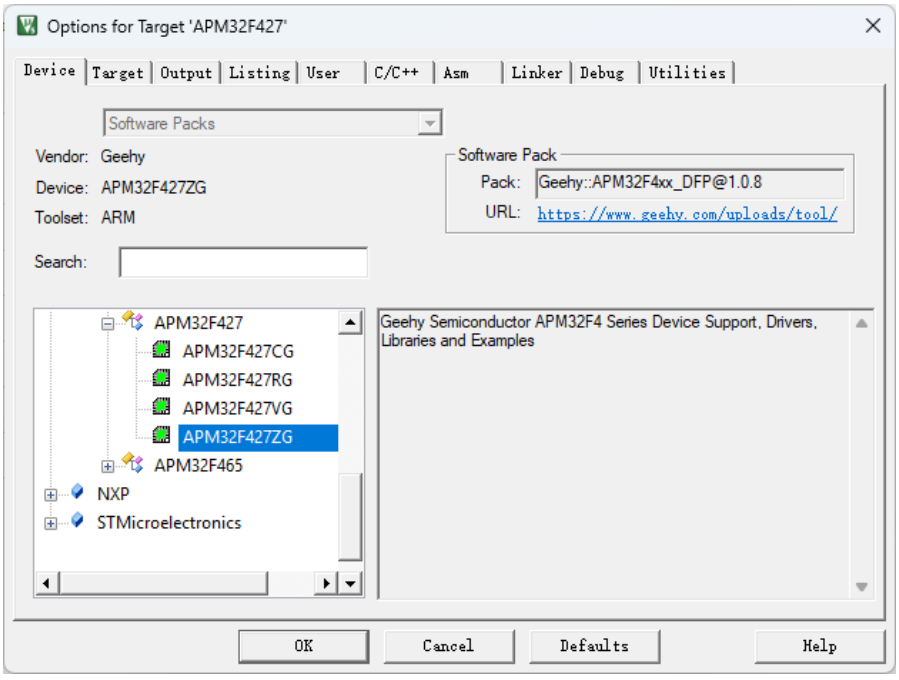
AN1086_APM32F4xx_ISP Application Note

AN1093_APM32_Eclipse Development Tutorial under APM32 Arm MCU Windows System

9.3.1. Configuration Engineer

After installing the Keil pack package toolchain with reference to the above document, open the Template MDK project and click the magic wand to confirm the chip selection. As shown in Figure 5, select APM32F427ZG for development.

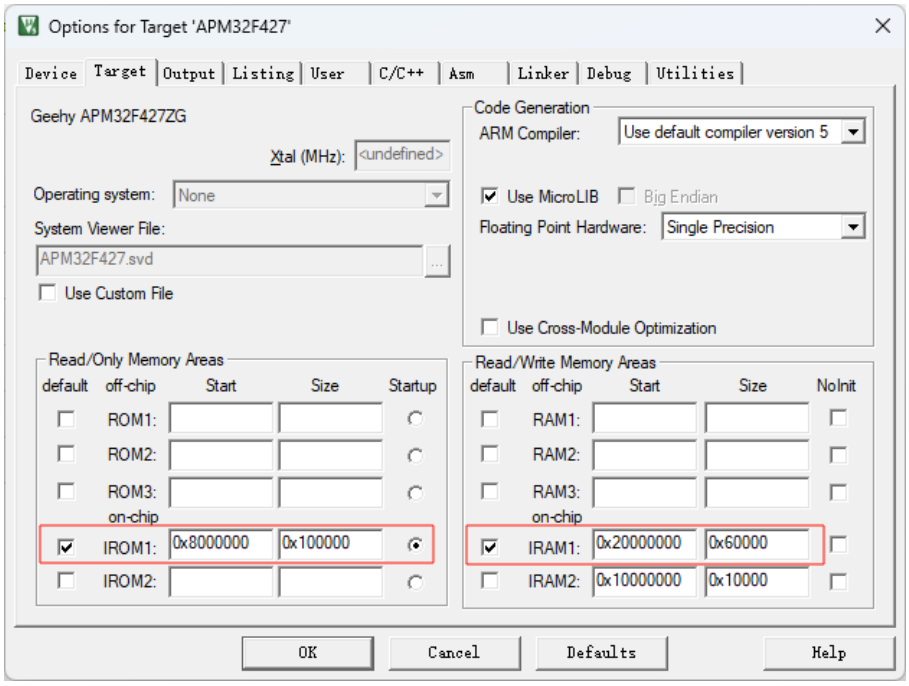
Figure 5 Check the chip selection



By switching the Target Tab, you can see the addresses and sizes of the ROM and RAM used

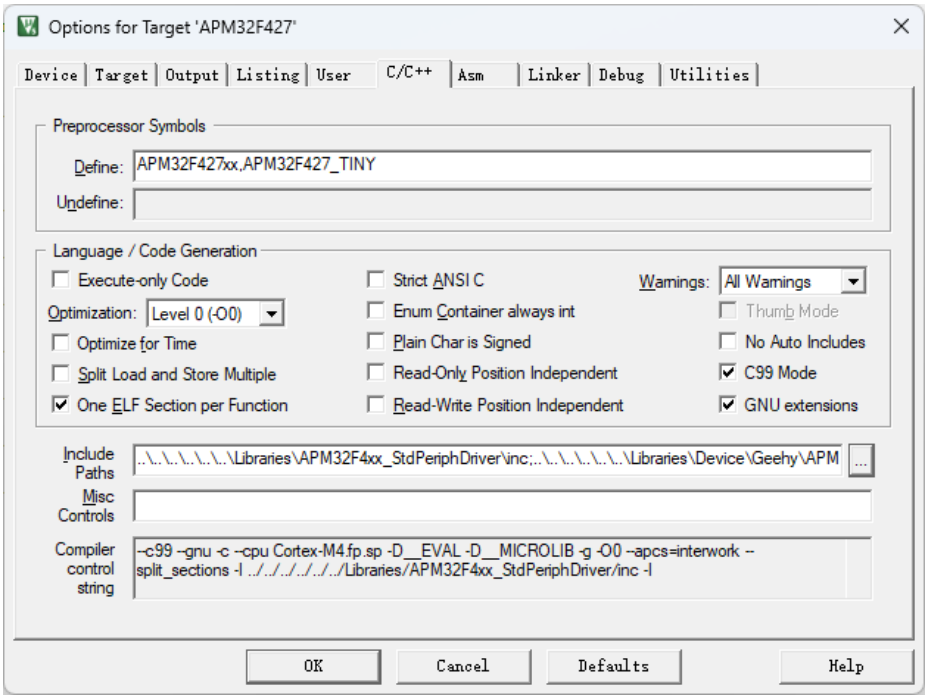
in the APM32F427ZG configuration.

Figure 6 ROM and RAM



Switch the C/C++ TAB and confirm that the APM32F427xx macro definition is enabled to support the development of APM32F427ZG.

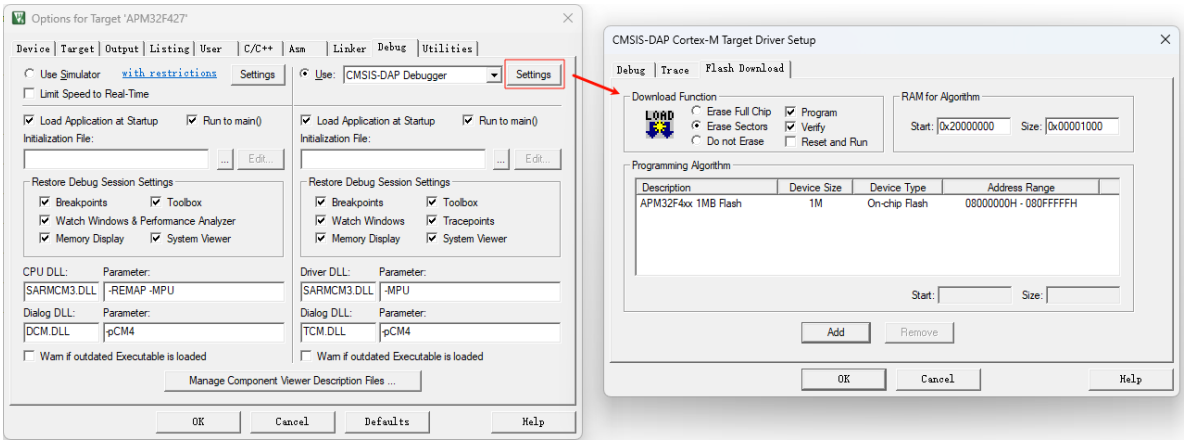
Figure 7 C/C++ configuration



Switch the Debug Tab, select the CMSS-DAP Debugger emulator, and enter the Flash Download TAB through the Settings button. Confirm that the APM32F4xx 1MB Flash download

algorithm is selected, as shown in Figure 8.

Figure 8 Debug



9.3.2. Compile Download

Click the "Build" button on the MDK interface to compile. After confirming that the compilation result is correct, click the "Download" button to download. The download result is shown in Figure 11.

Figure 9 Compile project

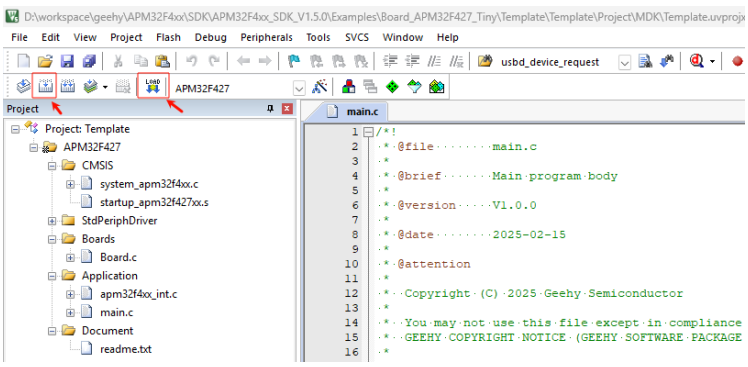


Figure 10 Compile result

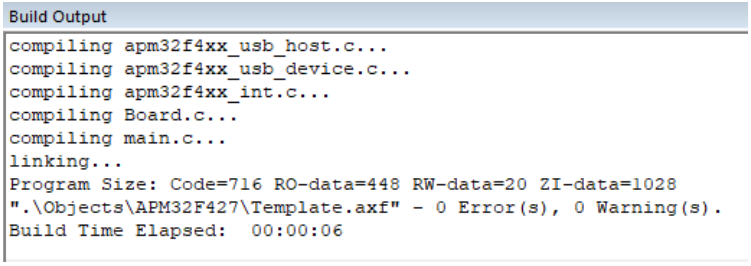


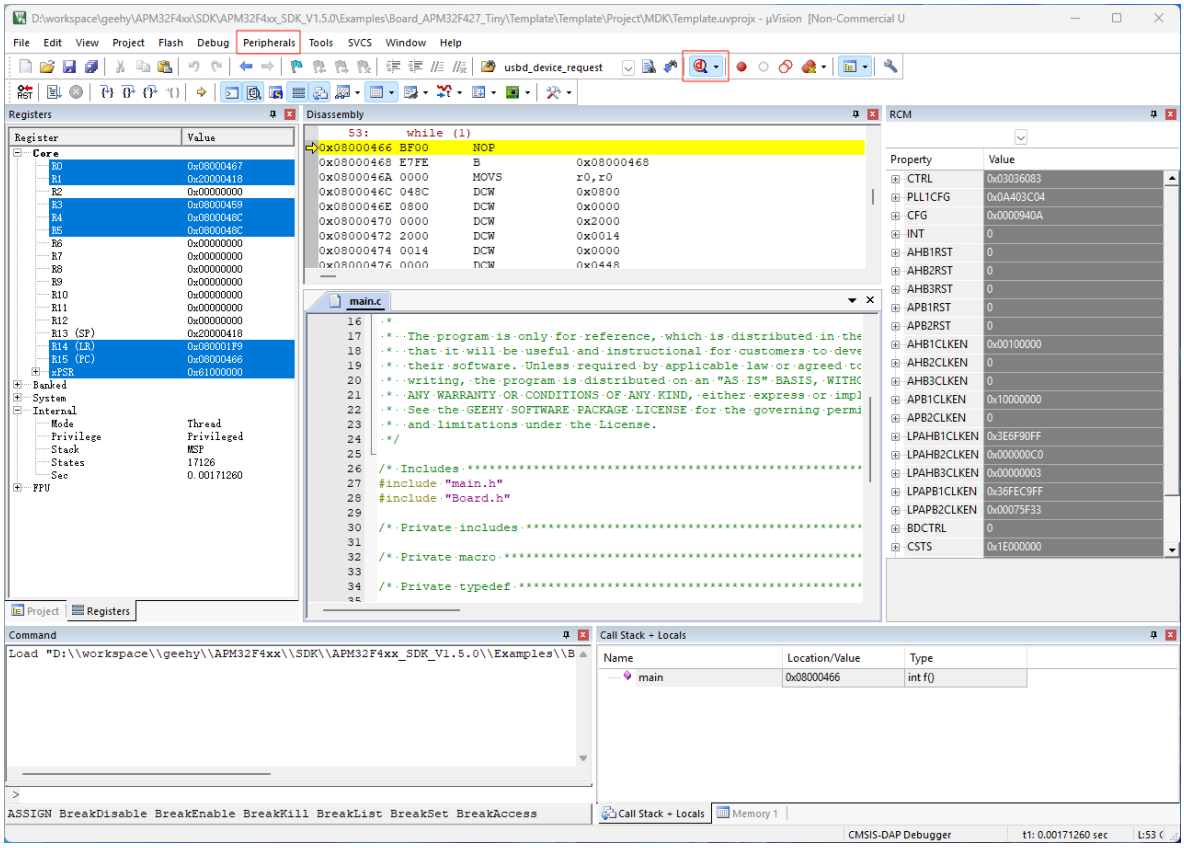
Figure 11 Download result

```
Build Output
linking...
Program Size: Code=716 RO-data=448 RW-data=20 ZI-data=1028
".\Objects\APM32F427\Template.axf" - 0 Error(s), 0 Warning(s
Build Time Elapsed:  00:00:06
Load "D:\\workspace\\geehy\\APM32F4xx\\SDK\\APM32F4xx_SDK_V1
Erase Done.
Programming Done.
Verify OK.
Flash Load finished at 14:39:45
```

9.3.3. Simulation Engineering

Click the Start/Stop Debug Session button on the interface to conduct simulation. In the simulation interface, you can view information such as the MCU core, peripheral Registers, and Memory data through the Peripherals, memory, and registers tabs.

图 1 Simulation engineering



10. Version History

Table 4 Document Version History

Date	Version	Change History
June,2025	1.0	New

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