

Application Note

Document No.: AN1157

APM32F4xx_SDK Quick Start Guide

Version: V1.0

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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 <u>www.geehy.com</u>.



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2. Regarding the SDK content

The complete SDK content is as follows

V APM32F4XX_SDK_V1.5.0 Board support package ✓ Boards > Board_APM32F407_Eval > Board_APM32F407_Mini > Board_APM32F407_Tiny > Board_APM32F411_Tiny > Board_APM32F427_Tiny C Board.c C Board.h ✓ Documents APM32F4xx_SDK_um.chm ▶ DATASHEET.pdf Examples Example for development board > Board_APM32F407_Eval > Board_APM32F407_Mini > Board_APM32F407_Tiny > Board_APM32F411_Tiny > Board_APM32F427_Tiny ✓ Libraries > APM32F4xx_StdPeriphDriver SPD library driver > CMSIS > Device Device header, startup and linker file Middleware ✓ Middlewares > APM32_USB_Library > CMSIS-FreeRTOS > FatFs > FreeRTOS > LwIP > RTThread ✓ Package > SVD Keil-MDK DFP Geehy.APM32F4xx_DFP.1.0.8.pack ■ GEEHY COPYRIGHT NOTICE.txt ■ Notice.txt ▶ Readme.pdf SDK readme Release_Notes.txt

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 \sim /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

PM32F4xx_SDK	
위 (위 수 ~ 이	
降蔵 亜抗 上一歩 約川 停止	御藤 生灯 予体 打印 認期(2)
日景(2) 素引(10) 接景(5) (2(東央(0))	
E f() ADC Driver	+ ADC_AnalogWatchdogLowThresholds()
🛞 🐑 Macros	
	void ADC_AnalogWatchdogLowThresholds (ADC_T* adc,
(i) 🎨 ADC_Structure	unt16_1 lowThreshold
ADC_runctions ADC_AnalogWatchdools	
ADC_ClearIntFlag	
ADC_ClearStatusFlag	Configures the specified ADC high and low thresholds of the analog watchdog.
ADC_CommonConfig	Parameters
ADC Config	ade ADC instance
ADC_ConfigAnalogWatch	In Threshold The BTC analyse watch-this is well-being the astronometry and the astronometry and the state of
ADC_ConfigAnalogWatch	en meaner inches another meaner the major and the major and the statement of a statement
ADC_ConfigDiscMode	Return values
ADC_ConfigExternalTrigi	None
ADC_ConfigInjectedChan	Padaline at the Add at River and Add at a
ADC_ConfigInjectedOffse	Determinent of the state of the shortestimate and the state of the sta
ADC_ConfigInjectedSequ ADC_ConfigUngetExemple	
a ADC_ConfigOverSamplin	ADC ClosetetEler()
ADC_ConfigOverSampin	*ADC_Cleanminag()
ADC_ConfigRegularChan ADC_ConfigRegularChan	void ADC_Cleantrifiag (ADC_T * adc,
ADC Disable	umr32_t flag
ADC_DisableAnalogWatc	
ADC_DisableAutoInjectec	
ADC_DisableContinuous/	Clears the specified ADC Interrupt pending bits.
ADC_DisableDMA	
ADC_DisableDMARequer	Planetors
ADC_DisableEOCOnEach	ado AU, Indance
ADC Disableinternunt	mag select me AUC memps source. This parameter can be any componant or ne tonowing values.
ADC_DisableMultiModeE	 ADC_INT_FLAG_EOC: End of conversion interrupt flag
ADC_DisableOverSampli	ADC_INT_FLAG_AWD: Analog watchdog interrupt flag
ADC_DisableTempSenso	ADC_INT_FLAG_INUECC: End of injected conversion interrupt flag
ADC Enable	 Aux_int_reas_over overtain interrupt mag
ADC_EnableAnalogWatcl	
ADC_EnableAutoInjected	Return values
ADC EnableContinuousN	None
ADC EnableDiscMode	Definition at line 1150 of file spm32f4xx adc.c.



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:

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

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
	CAN_Normal	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark				
CRC	CRC_Calculation	\checkmark	\checkmark		\checkmark	\checkmark				
COMP	COMP_PWMBreak				\checkmark					
COMP	COMP_WindowComparator				\checkmark					
	CRYP_AES	\checkmark								
CRYP	CRYP_DES-TDES	\checkmark								
DAC	DAC_ADC	\checkmark	\checkmark			\checkmark				
DCI	DCI_OV2640	\checkmark		\checkmark						
DMC	DMC_SDRAM			\checkmark						
	DMA_ADC	\checkmark	\checkmark			\checkmark				
DMA	DMA_FIFOMode	\checkmark	\checkmark		\checkmark					
	DMA_FMCToRAM	\checkmark	\checkmark		\checkmark	\checkmark				
	DSP_bayes	\checkmark								
	DSP_class_marks	\checkmark								
	DSP_convolution	\checkmark								
	DSP_dotproduct	\checkmark								
	DSP_fft_bin	\checkmark								
	DSP_fir	\checkmark								
5.05	DSP_graphic_equalizer	\checkmark								
DSP	DSP_linear_interp	\checkmark								
	DSP_matrix	\checkmark								
	DSP_signal_converge	\checkmark								
	DSP_sin_cos	\checkmark								
	DSP_svm	V								
	DSP_Template	V								
	DSP_variance	\checkmark								
EINT EINT_Config		\checkmark	\checkmark		\checkmark	\checkmark				
ETH	ETH_Ping		\checkmark	\checkmark		\checkmark				



IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
	ETH_TCP_client		\checkmark	\checkmark		\checkmark				
	ETH_TCP_server		\checkmark	\checkmark		\checkmark				
FMO	Flash_Emulation_Eeprom	\checkmark	\checkmark							
FINC	FMC_Write	\checkmark	\checkmark		\checkmark	\checkmark				
GPIO	GPIO_Toggle	\checkmark	\checkmark		\checkmark	\checkmark				
HASH	HASH_SHA1	\checkmark								
	I2C_TwoBoards_Master	\checkmark	\checkmark		\checkmark					
10.0	I2C_TwoBoards_Slave	\checkmark	\checkmark		\checkmark					
120	I2C_TwoBoardsPolling					\checkmark				
	I2C_EEPROM		\checkmark							
	Application1	\checkmark	\checkmark		\checkmark	\checkmark				
IAP	Application2	\checkmark	\checkmark		\checkmark	\checkmark				
	Bootloader	\checkmark	\checkmark		\checkmark	\checkmark				
I2S	I2S_Interrupt	\checkmark	\checkmark		\checkmark					
IWDT	IWDT_Reset	\checkmark	\checkmark		\checkmark	\checkmark				
NIX (10)	NVIC_Priority	\checkmark	\checkmark		\checkmark	\checkmark				
NVIC	NVIC_WFI	\checkmark	\checkmark		\checkmark	\checkmark				
1.05	LCD_ShowFigure			\checkmark						
LCD	LCD_TOUCH			\checkmark						
	PMU_BOR	\checkmark	\checkmark			\checkmark				
	PMU_Consumption	\checkmark	\checkmark		\checkmark	\checkmark				
PMU	PMU_PVD	\checkmark	\checkmark			\checkmark				
	PMU_STANDBY	\checkmark	\checkmark		\checkmark	\checkmark				
	PMU_STOP	\checkmark	\checkmark		\checkmark	\checkmark				
	QSPI_ReadWrite				\checkmark	\checkmark				
QSPI	QSPI_ReadWriteDMA				\checkmark	\checkmark				
	QSPI_ReadWriteInterrupt				\checkmark	\checkmark				
RCM	RCM_ClockConfig	\checkmark	\checkmark		\checkmark	\checkmark				



IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
RNG	RNG_MultiRNG	\checkmark	\checkmark		\checkmark	\checkmark				
DTC	RTC_Alarm	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark				
RIC	RTC_Calendar			\checkmark						
	FreeRTOS	\checkmark			\checkmark					
DTOC	RT-thread	\checkmark	\checkmark		\checkmark					
RIUS	CMSIS_FreeRTOS		\checkmark			\checkmark				
	CMSIS_RTX		\checkmark			\checkmark				
SDIO SDIO_SDCard		\checkmark		\checkmark	\checkmark	\checkmark				
<u>en</u> i	SPI_FullDuplex	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark				
581	SPI_Flash			\checkmark						
Template	Template	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark				
	TMR_6Steps	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_32BitCount	\checkmark	\checkmark			\checkmark				
	TMR_CascadeSynchro	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_EncoderInterface	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_ExtTriggerSynchro	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_InputCapture	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_OCActive	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_OCInactive	\checkmark	\checkmark		\checkmark	\checkmark				
TMR	TMR_OCToggle	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_ParallelSynchro	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_PWMInput	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_PWMOutput	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_SinglePulse	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_TimeBase	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_TMR1DMABurst	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_TMR1PWMOutput	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_TMR1Synchro	\checkmark	\checkmark		\checkmark	\checkmark				



IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	NA	NA
	TMR_TMR2PWMOutput	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_TMR8DMA	\checkmark	\checkmark		\checkmark	\checkmark				
	TMR_TMR9OCToggle	\checkmark	\checkmark			\checkmark				
	TMR_TMR11PWMOutput	\checkmark	\checkmark			\checkmark				
	USART_IrDA	\checkmark				\checkmark				
	USART_LIN	\checkmark				\checkmark				
	USART_Printf	\checkmark				\checkmark				
	USART_Smartcard	\checkmark				\checkmark				
	USART_TwoBoardsDMA	\checkmark	\checkmark		\checkmark	\checkmark				
USARI	USART_TwoBoardsInterrupt	\checkmark	\checkmark		\checkmark	\checkmark				
	USART_TwoBoardsPolling	\checkmark	\checkmark		\checkmark	\checkmark				
	USART_Interrupt			\checkmark						
	USART_Polling			\checkmark						
	USART_RS485			\checkmark						
	OTGD_CDC	\checkmark		\checkmark	\checkmark	\checkmark				
	OTGD_Custom_HID	\checkmark			\checkmark	\checkmark				
	OTGD_Custom_HID_Keyboard	\checkmark		\checkmark	\checkmark	\checkmark				
	OTGD_HID	\checkmark		\checkmark	\checkmark	\checkmark				
	OTGD_HID_Keyboard	\checkmark		\checkmark	\checkmark	\checkmark				
	OTGD_HID_WakeUp_LowPower	\checkmark			\checkmark	\checkmark				
070 50	OTGD_MSC	\checkmark		\checkmark	\checkmark	\checkmark				
OIGFS	OTGD_MSC_LowPower	\checkmark			\checkmark	\checkmark				
	OTGD_MSC_NorFlash			\checkmark						
	OTGD_MSC_SDCard			\checkmark						
	OTGD_WINUSB	\checkmark		\checkmark	\checkmark	\checkmark				
	OTGD_Composite_CDC	\checkmark			\checkmark	\checkmark				
_	OTGD_Composite_CDC_HID	\checkmark			\checkmark	\checkmark				
	OTGD_Composite_CDC_MSC	\checkmark			\checkmark	\checkmark				



IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	NA	ΥN	ΨN
	OTGD_Composite_CDC_WINUSB	\checkmark			\checkmark	\checkmark				
	OTGD_Composite_HID_MSC	\checkmark			\checkmark	\checkmark				
	OTGD_Composite_HID_WINUSB	\checkmark			\checkmark	\checkmark				
	OTGD_Composite_MSC_WINUSB	\checkmark			\checkmark	\checkmark				
	OTGD_Composite_WINUSB	\checkmark			\checkmark	\checkmark				
	OTGH_CDC	\checkmark			\checkmark	\checkmark				
	OTGH_DynamicSwitch	\checkmark			\checkmark	\checkmark				
	OTGH_HID	\checkmark			\checkmark	\checkmark				
	OTGH_MSC	\checkmark			\checkmark	\checkmark				
	OTGH_MSC_FWUpgrade	\checkmark			\checkmark	\checkmark				
	OTGD_CDC_FS2					\checkmark				
OTG FS2	OTGD_HID_WakeUp_LowPower_FS2					\checkmark				
	OTGH_CDC_FS2					\checkmark				
	OTGD_MSC_HS1	\checkmark								
OTG HS1	OTGD_MSC_HS_IN_FS		\checkmark							
	OTGH_HID_HS1	\checkmark								
	OTGD_MSC_NorFlash_HS2			\checkmark						
	OTGD_MSC_SDCard_HS2			\checkmark						
	OTGD_CDC_HS2		\checkmark							
	OTGD_Composite_CDC_HID_HS2		\checkmark							
	OTGD_Composite_CDC_HS2		\checkmark							
	OTGD_Composite_CDC_MSC_HS2		\checkmark							
01G HS2	OTGD_Composite_CDC_WINUSB_HS2		\checkmark							
	OTGD_Composite_HID_MSC_HS2		\checkmark							
	OTGD_Composite_HID_WINUSB_HS2		\checkmark							
	OTGD_Composite_MSC_WINUSB_HS2		\checkmark							
_	OTGD_Composite_WINUSB_HS2		\checkmark							
	OTGD_Custom_HID_Keyboard_HS2		\checkmark							



IP / Module	Example	APM32F407_MINI	APM32F407_TINY	APM32F407_EVAL	APM32F411_TINY	APM32F427_TINY	NA	AN	NA	NA
	OTGD_HID_HS2		\checkmark							
	OTGD_HID_LowPower_HS2		\checkmark							
	OTGD_MSC_HS2		\checkmark							
	OTGD_WINUSB_HS2		\checkmark							
	OTGH_CDC_HS2		\checkmark	\checkmark						
	OTGH_HID_HS2		\checkmark	\checkmark						
	OTGH_MSC_HS2		\checkmark	\checkmark						
DRD	DRD_MSC_CDC_DualCore			\checkmark						
Duel Care	MSC_CDC_DualCore			\checkmark						
Dual Cole	OTGD_CDC_DualCore			\checkmark						
WWDT	WWDT_OverTime	\checkmark	\checkmark		\checkmark	\checkmark				



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.

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

Table 2 List of SPD drivers supported by the device

www.geehy.com



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

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 \sim /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.





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.

Macro Definition	describe	remark
	Enable support for the APM32F405RG, APM32F405VG and	
APM32F405XX	APM32F405ZG models	
	Enable support for the APM32F407VG, APM32F407VE,	
APM32F407xx	APM32F407ZG, APM32F407ZE, APM32F407IG and APM32F407IE	
	models	
	Enable support for the APM32F415VG, APM32F415VE,	
APM32F415xx	APM32F415ZG, APM32F415ZE, APM32F415IG and APM32F415IE	
	models	
	Enable support for the APM32F417VG, APM32F417VE,	
APM32F417xx	APM32F417ZG, APM32F417ZE, APM32F417IG and APM32F417IE	
	models	
	Enable support for the APM32F411CC, APM32F411CE,	
APM32F411xx	APM32F411RC, APM32F411RE, APM32F411VC and	
	APM32F411VE models	
	Enable support for the APM32F425ZG, APM32F425VG,	
AF 10321-423XX	APM32F425RG and APM32F425CG models	
	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	IY 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.

Options for Target 'APM32F427' X			
Device Target Output Listing User C/C++ Asm Linker Debug Utilities			
Geehy APM32F427ZG <u>X</u> tal (MHz): (undefinedscore	Code Generation ARM Compiler: Use default compiler version 5		
Operating system: None 🗸	🔽 Use MicroLIB 🔲 Bjg Endian		
System Viewer File:	Floating Point Hardware: Single Precision		
APM32F427.svd			
Use Custom File			
Use Cross-Module Optimization			
Read/Only Memory Areas	Read/Write Memory Areas		
default off-chipStartSizeStartup	default off-chip Start Size Nolnit		
□ ROM1: 0	□ RAM1: □		
□ ROM2: □ ○	□ RAM2: □ □		
□ ROM3: □ C	RAM3:		
on-chip	on-chip		
IROM1: 0x8000000 0x100000 €	IRAM1: 0x20000000 0x60000 □		
IROM2: C	□ IRAM2: 0x1000000 0x10000 □		
OK Ca	ncel Defaults Help		

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

Options for Target 'APM32	F427'	×
Device Target Output Li	sting User C/C++ Asm Linker Debug	Vtilities
Preprocessor Symbols Define: APM32F427xx,/	PM32F427_TINY	
Language / Code Generatio	1	
Execute-only Code	Strict ANSIC War	nings: All Warnings 💌
Optimization: Level 0 (-00)	Enum <u>C</u> ontainer always int	Thum <u>b</u> Mode
Optimize for Time	 Plain Char is Signed	No Auto Includes
Split Load and Store Mul	iple 🔲 Read-Only Position Independent	C99 Mode
One ELF Section per Fur	ction <u>R</u> ead-Write Position Independent	GNU extensions
Include Paths <u>M</u> isc Controls	raries\APM32F4xx_StdPeriphDriver\inc;\\\\\\Librar	ies\Device\Geehy\APM
Compiler -c99 -gnu -c -cpu Cortex-M4.fp.sp -D_EVAL -D_MICROLIB -g -O0 -apcs=interwork - split_sections -l .///Libraries/APM32F4xx_StdPeriphDriver/inc -l		
	OK Cancel Defaults	Help

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.



9.3.2. Compile Download

Build Output

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.







compiling apm32f4xx_usb_host.c		
compiling apm32f4xx_usb_device.c		
compiling apm32f4xx_int.c		
compiling Board.c		
compiling main.c		
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		



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.

D:\workspace\geehy\APM32F4xx\SDK\APM32F4xx SDK	V1.5.0\Examples\Board APM32F427 Tiny\Template\Template\Project\M	DK\Template.uvproix - µVision [Non-Commerc	ial U	- 0) ×
File Edit View Project Elash Debug Peripherals	Tools SVCS Window Help				
	1월 1월 1월 1章 1후 1/2 //2 📴 usbd_device_request 🖂 📓		*		
👬 🗒 🖸 🖰 😚 😗 👘 🔚	🛃 🖉 T 🛄 T 📴 T 🎇 T 🎬 T 🔟 T 💹 T				
Registers 🗜 🗶	Disassembly	a 🛛	RCM		Ф 🗙
Register Value	53: while (1)			\sim	
B-Core	Cx08000466 BF00 NOP		Property.	Value	
E0 0x08000467	0x08000468 E7FE B 0x08000468		- crev	value	_
R1 0x2000418	0x0800046C 048C DCW 0x0800		H CIKL	UXU3U30083	
R3 0x08000459	0x0800046E 0800 DCW 0x0000	1	PLL1CFG	0x0A403C04	
R4 0x0800048C	0x08000470 0000 DCW 0x2000			0x0000940A	
R5 0x0800048C	0x08000472 2000 DCW 0x0014				
105 UXUUUUUUU 177 0v00000000	0x08000474 0014 DCW 0x0000		AHB1RST		
	0x08000476 0000 DCW 0x0448		+ AHB2RST		
	—		AHB3RST		
R10 0x0000000	main.c	▼ X	ADDIDGT	0	
R12 0x0000000	16		APBIRST	0	
- R13 (SP) 0x20000418	17 *··The·program·is·only·for·reference.	which.is.distributed.in.the	APB2RST		
R14 (LR) 0x080001F9	18 * • that it will be useful and instruct	ctional for customers to deve	AHB1CLKEN	0x00100000	
R15 (PC) 0x08000466	19 ** their software. Unless required by	y-applicable-law-or-agreed-tc	AHB2CLKEN		
T Banked	20 ·*··writing, ·the ·program ·is ·distribute	ed on an "AS IS" BASIS, WITH	AHB3CLKEN		
🗄 System	21 * · · ANY · WARRANTY · OR · CONDITIONS · OF · ANY	KIND, either express or impl	APB1CLKEN	0x10000000	
Internal	22 * · · See · the · GEEHY · SOFTWARE · PACKAGE · LI	CENSE for the governing permi	→ APB2CLKEN		
Mode Thread	23 * • and limitations under the License	· []		0.25650055	
Stack MSP	24 **/			0.00000000	
States 17126	25 - 26 /* .Tooludes .**************************		+ LPAHB2CLKEN	0x00000000	
Sec 0.00171260	27 #include."main h"		LPAHB3CLKEN	0x00000003	
T	28 #include "Board.h"		LPAPB1CLKEN	0x36FEC9FF	
	29		LPAPB2CLKEN	0x00075F33	
	30 /* ·Private · includes · ***********************************	*********	BDCTRL	0	
	31		CSTS	0x1E000000	-
	32 /* · Private · macro · ***********************************	******	T		
	33				
<u> </u>	34 /*·Private·typeder·				
🖭 Project 🛛 🚟 Registers	J				
Command	4 🛛 Call Stack +	Locals			4 🔀
Load "D:\\workspace\\geehy\\APM32F4xx\\S	DK\\APM32F4xx_SDK_V1.5.0\\Examples\\B A Name	Location/Value	Туре		
	🔍 ma	in 0x08000466	int f()		
	Ψ				
>					
ASSIGN BreakDisable BreakEnable BreakKil	l BreakList BreakSet BreakAccess 🛛 🖓 🖓 Call Sta	ck + Locals Memory 1			
		CMSIS-I	DAP Debugger	t1: 0.00171260 sec	LISS Cold

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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