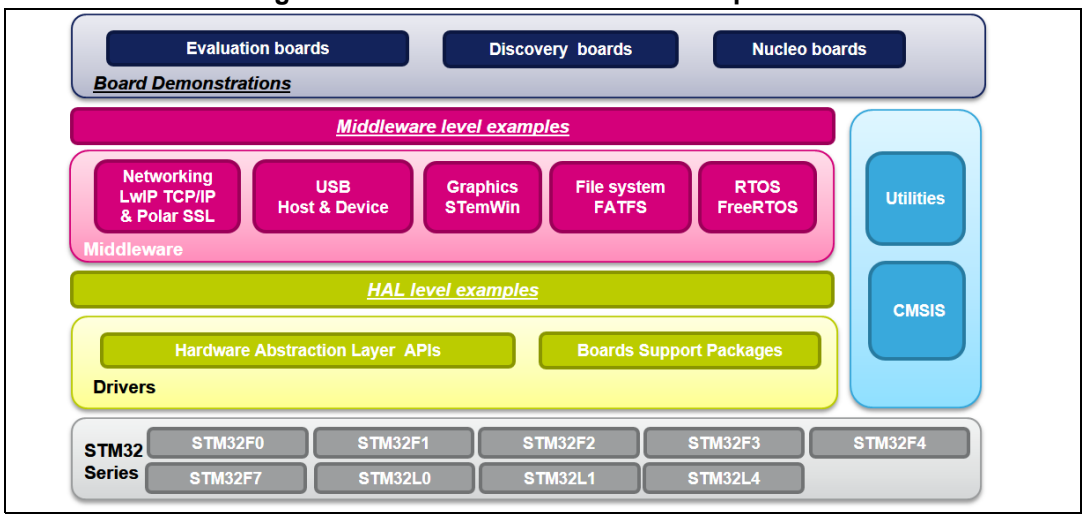
AN4724
Application note

STM32Cube firmware examples for STM32F1 Series

Introduction

The STM32CubeF1 firmware package comes with a rich set of examples running on STMicroelectronics boards. The examples are organized by board and provided with preconfigured projects for the main supported toolchains (see *Figure 1*).

Figure 1. STM32CubeF1 firmware components



Reference documents

The following user manuals are available on www.st.com/stm32cube:

- Latest release of STM32CubeF1 firmware package
- *Getting started with the STM32CubeF1 firmware package for the STM32F1 series* (UM1847)
- *STM32CubeF1 Nucleo demonstration firmware* (UM1853)
- *Description of STM32F1xx HAL drivers* (UM1850)
- *STM32Cube USB Device library* (UM1734)
- *STM32Cube USB host library* (UM1720)
- *Developing applications on STM32Cube with FatFs* (UM1721)
- *Developing Applications on STM32Cube™ with RTOS* (UM1722)
- *Developing applications on STM32Cube with LwIP TCP/IP stack* (UM1713)
- *STM32Cube Ethernet IAP example* (UM1709)

STM32CubeF1 examples

The examples are classified depending on the STM32Cube™ level they apply to. They are named as follows:

- **Examples:** the examples use only the HAL and BSP drivers (middleware not used). Their objective is to demonstrate the product/peripherals features and usage. They are organized per peripheral (one folder per peripheral, e.g. TIM). Their complexity level ranges from the basic usage of a given peripheral (e.g. PWM generation using timer) to the integration of several peripherals (e.g. how to use DAC for signal generation with synchronization from TIM6 and DMA). The usage of the board resources is reduced to the strict minimum.
- **Applications:** the applications demonstrate the product performance and how to use the available middleware stacks. They are organized either by middleware (a folder per middleware, e.g. USB Host) or by product feature that require high-level firmware bricks (e.g. Audio). The integration of applications that use several middleware stacks is also supported.
- **Demonstrations:** the demonstrations aim to integrate and run the maximum number of peripherals and middleware stacks to showcase the product features and performance.
- **Template project:** the template project is provided to allow to quickly build a firmware application on a given board.

The examples are located under *STM32Cube_FW_F1_VX.Y.Z\Projects*\. They all have the same structure:

- *Inc* folder containing all header files
- *Src* folder containing the sources code
- *EWARM*, *MDK-ARM*, *SW4STM32* and *TrueSTUDIO* folders containing the preconfigured project for each toolchain.
- readme.txt file describing the example behavior and the environment required to run the example.

To run the example, proceed as follows:

1. Open the example using your preferred toolchain.
2. Rebuild all files and load the image into target memory.
3. Run the example by following the readme.txt instructions

Note: Refer to "Development toolchains and compilers" and "Supported devices and evaluation boards" sections of the firmware package release notes to know more about the software/hardware environment used for the firmware development and validation. The correct operation of the provided examples is not guaranteed in other environments, for example when using different compiler or board versions.

The examples can be tailored to run on any compatible hardware: simply update the BSP drivers for your board, provided it has the same hardware functions (LED, LCD display, pushbuttons, etc.). The BSP is based on a modular architecture that can be easily ported to any hardware by implementing the low-level routines.

Table 1 contains the list of examples provided within STM32CubeF1 firmware package.

Table 1. STM32CubeF1 firmware examples

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Templates	-	Starter project	This projects provides a reference template that can be used to build any firmware application.	X	X	X	X
Total number of templates: 4				1	1	1	1
Examples	-	BSP	This example provides a description of how to use the different BSP drivers.	X	-	-	X
	ADC	ADC_AnalogWatchdog	This example provides a short description of how to use the ADC peripheral to perform conversions with analog watchdog and out-of-window interruptions enabled.	-	-	X	-
		ADC_DualModeInterleaved	This example provides a short description of how to use two ADC peripherals to perform conversions in interleaved dual-mode.	X	-	-	-
		ADC_Regular_injected_groups	This example provides a short description of how to use the ADC peripheral to perform conversions using the two ADC groups: regular group for ADC conversions on main stream and injected group for ADC conversions limited on specific events (conversions injected within main conversions stream).	X	X	-	-
		ADC_Sequencer	This example provides a short description of how to use the ADC peripheral with sequencer, to convert several channels.	-	-	-	X
	CAN	CAN_Networking	This example shows how to configure the CAN peripheral to send and receive CAN frames in normal mode.	-	-	-	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Examples	CRC	CRC_Example	This example guides you through the different configuration steps by means of the HAL API. The CRC (Cyclic Redundancy Check) calculation unit computes the CRC code of a given buffer of 32-bit data words, using a fixed generator polynomial (0x4C11DB7).	X	X	X	X
	Cortex	CORTEXM_MPU	This example presents the MPU features on STM32F1xx devices and it can be easily ported to any other STM32 device supporting MPU.	-	-	-	X
		CORTEXM_ModePrivilege	This example shows how to modify Thread mode privilege access and stack. Thread mode is entered on reset or when returning from an exception.	-	-	-	X
		CORTEXM_SysTick	This example shows how to use the default SysTick configuration with a 1 ms timebase to toggle LEDs.	-	-	-	X
	DAC	DAC_SignalsGeneration	This example provides a description of how to use the DAC peripheral to generate several signals using DMA controller.	X	-	-	-
		DAC_SimpleConversion	This example provides a short description of how to use the DAC peripheral to do a simple conversion.	-	-	-	X
	DMA	DMA_FLASHToRAM	This example provides a description of how to use a DMA channel to transfer a word data buffer from FLASH memory to embedded SRAM memory through the HAL API.	-	-	-	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Examples	FLASH	FLASH_EraseProgram	This example describes how to configure and use the FLASH HAL API to erase and program the internal FLASH memory.	-	-	X	-
		FLASH_WriteProtection	This example describes how to configure and use the FLASH HAL API to enable and disable the write protection of the internal FLASH memory.	-	-	X	-
	FSMC	FSMC_NAND	This example describes how to configure the FSMC controller to access the NAND memory.	-	-	-	X
		FSMC_NOR	This example describes how to configure the FSMC controller to access the NOR memory.	-	-	-	X
		FSMC_NOR_CodeExecute	This example describes how to build an application to be loaded into the NOR memory mounted on board and then execute it from internal Flash.	-	-	-	X
		FSMC_SRAM	This example describes how to configure the FSMC controller to access the SRAM memory.	-	-	-	X
		FSMC_SRAM_DataMemory	This example describes how to configure the FSMC controller to access the SRAM memory including heap and stack.	-	-	-	X
	GPIO	GPIO_EXTI	This example shows how to configure external interrupt lines.	-	X	-	-
		GPIO_IOToggle	This example describes how to configure and use GPIOs through the HAL API.	X	X	X	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Examples	HAL	HAL_TimeBase	This example describes how to customize the HAL time base using a general purpose timer instead of Systick as main source of time base.	-	-	X	-
	I2C	I2C_TwoBoards_AdvComIT	This example describes how to perform I2C data buffer transmission/reception between two boards, using an interrupt.	-	-	X	X
		I2C_TwoBoards_ComDMA	This example describes how to perform I2C data buffer transmission/reception between two boards, via DMA.	-	-	X	X
		I2C_TwoBoards_ComIT	This example describes how to perform I2C data buffer transmission/reception between two boards using an interrupt.	-	-	X	X
		I2C_TwoBoards_ComPolling	This example describes how to perform I2C data buffer transmission/reception between two boards in Polling mode.	-	-	X	X
	I2S	I2S_Audio	This example provides basic implementation of audio features.	X	-	-	-
	IWDG	IWDG_Example	This example describes how to reload the IWDG counter and to simulate a software fault by generating an MCU IWDG reset when a programmed time period has elapsed.	X	-	-	-

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Examples	PWR	PWR_PVD	This example shows how to configure the programmable voltage detector using an external interrupt line. External DC supply has to be used to power Vdd.	-	-	-	X
		PWR_SLEEP	This example shows how to enter Sleep mode and wake up from this mode by using an interrupt.	-	X	-	-
		PWR_STANDBY	This example shows how to enters the system to STANDBY mode and wake-up from this mode using: external RESET or WKUP pin.	-	-	X	-
	RCC	RCC_ClockConfig	This example describes how to use the RCC HAL API to configure the system clock (SYSCLK) and modify the clock settings in run mode.	X	X	X	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Examples	RTC	RTC_Alarm	This example guides you through the different configuration steps by means of the RTC HAL API to configure and generate an RTC alarm.	-	-	X	-
		RTC_Calendar	This example guides you through the different configuration steps by mean of HAL API to ensure Calendar configuration using the RTC peripheral.	-	-	-	X
		RTC_LSI	This example demonstrates and explains how to use the LSI clock source auto calibration to get a precise RTC clock.	X	-	-	-
		RTC_LowPower_STANDBY	This example shows how to enter the system to STANDBY mode and wake-up from this mode using RTC Alarm Event connected to EXTI_Line17.	-	X	-	-
		RTC_Tamper	This example guides you through the different configuration steps by means of the RTC HAL API to write/read data to/from RTC Backup registers and demonstrate the tamper detection feature.	-	-	-	X
	SMARTCARD	SMARTCARD_T0	This example describes a firmware Smartcard Interface based on the USART peripheral. The main purpose of this firmware example is to provide resources facilitating the development of an application using the USART peripheral in smartcard mode.	X	-	-	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Examples	SPI	SPI_FullDuplex_ComDMA	This example shows how to perform SPI data buffer transmission/reception between two boards via DMA.	-	X	X	-
		SPI_FullDuplex_ComIT	This example shows how to ensure SPI data buffer transmission/reception between two boards by using an interrupt.	-	X	X	-
		SPI_FullDuplex_ComPolling	This example shows how to ensure SPI data buffer transmission/reception in Polling mode between two boards.	-	X	X	-
	TIM	TIM_ComplementarySignals	This example shows how to configure the TIM1 peripheral to generate three complementary TIM1 signals, to insert a defined dead time value, to use the break feature and to lock the desired parameters.	-	-	-	X
		TIM_DMA	This example provides a description of how to use DMA with TIM1 Update request to transfer Data from memory to TIM1 Capture Compare Register 3 (CCR3).	-	-	X	X
		TIM_InputCapture	This example shows how to use the TIM peripheral to measure the frequency of an external signal.	-	-	-	X
		TIM_PWMOutput	This example shows how to configure the TIM peripheral in PWM (Pulse Width Modulation) mode.	-	-	-	X
		TIM_TimeBase	This example shows how to configure the TIM peripheral to generate a time base of one second with the corresponding Interrupt request.	X	X	X	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Examples	UART	UART_HyperTerminal_DMA	This example shows how to ensure UART Data buffer transmission and reception with DMA. The communication is done with the Hyperterminal PC application.	X	X	X	-
		UART_Printf	This example shows how to reroute the C library printf function to the UART. It outputs a message sent by the UART on the HyperTerminal.	X	X	X	X
		UART_TwoBoards_ComDMA	This example describes an UART transmission (transmit/receive) in DMA mode between two boards.	X	X	X	-
		UART_TwoBoards_ComIT	This example describes a UART transmission (transmit/receive) in interrupt mode between two boards.	X	X	X	-
		UART_TwoBoards_ComPolling	This example describes a UART transmission (transmit/receive) in polling mode between two boards.	X	X	X	-
	WWDG	WWDG_Example	This example guides you through the different configuration steps by means of the HAL API to perform periodic WWDG counter update and simulate a software fault that generates an MCU WWDG reset when a predefined time period has elapsed.	-	-	X	-
Total number of examples: 87				17	16	24	30
Demonstrations	-	Adafruit_LCD_1_8_SD_Joystick	The provided demonstration firmware based on STM32Cube helps you to discover STM32 Cortex-M devices that can be plugged on a STM32NUCLEO board.	-	-	X	-
Total number of demonstrations: 1				0	0	1	0

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Applications	EEPROM	EEPROM_Emulation	Please refer to AN2594 for futher details regarding this application.	-	-	X	-
	FatFs	FatFs_uSD	This example provides a description on how to use STM32Cube firmware with FatFs middleware component as a generic FAT file system module. The objective is to develop an application using most of the features offered by FatFs to configure a microSD drive.	X	-	-	X
	FreeRTOS	FreeRTOS_ThreadCreation	This directory contains a set of source files that implement a thread creation example using CMSIS RTOS API.	X	-	X	X
	IAP	IAP_Binary_Template	This directory contains a set of sources files that build the application to be loaded into Flash memory using In-Application Programming (IAP through USART).	X	-	-	-
		IAP_Main	This directory contains a set of sources files and pre-configured projects that describes how to build an application to be loaded into Flash memory using In-Application Programming (IAP, through USART).	X	-	-	-

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Applications	LwIP	LwIP_TCP_Echo_Client	This example guides STM32Cube HAL API users to run TCP Echo Client application based on Raw API of LwIP TCP/IP stack To run this application, On the remote PC, open a command prompt window.	X	-	-	-
		LwIP_TCP_Echo_Server	This example guides STM32Cube HAL API users to run TCP Echo Server application based on Raw API of LwIP TCP/IP stack To run this application, On the remote PC, open a command prompt window.	X	-	-	-
		LwIP_UDP_Echo_Client	This example guides STM32Cube HAL API users to run a UDP Echo Client application based on Raw API of LwIP TCP/IP stack To run this application, On the remote PC, open a command prompt window.	X	-	-	-
		LwIP_UDP_Echo_Server	This example guides STM32Cube HAL API users to run UDP Echo Server application based on Raw API of LwIP TCP/IP stack To run this application, On the remote PC, open a command prompt window.	X	-	-	-
	STemWin	STemWin_HelloWorld	This application shows how to implement a simple "Hello World" example based on STemWin.	X	-	-	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Applications	USB_Device	CDC_Standalone	This application shows how to use the USB device application based on the Device Communication Class (CDC) following the PSTN subprotocol using the USB Device and UART peripherals.	X	-	-	X
		CustomHID_Standalone	This application shows how to use the USB device application based on the Custom HID Class.	X	-	-	X
		DFU_Standalone	This application presents a compliant implementation of the Device Firmware Upgrade (DFU) capability for programming the embedded flash memory through the USB peripheral.	X	-	-	X
		HID_Standalone	This application shows how to use the USB device application based on the Humain Interface (HID).	X	-	X	X
		MSC_Standalone	This application shows how to use the USB device application based on the Mass Storage Class (MSC).	X	-	-	X

Table 1. STM32CubeF1 firmware examples (continued)

Level	Module Name	Project Name	Description	STM3210C-EVAL	STM32VL DISCOVERY	NUCLEO-F103RB	STM3210E-EVAL
Applications	USB_Host	CDC_Standalone	This application shows how to use the USB host application based on the CDC class.	X	-	-	-
		HID_RTOS	This application shows how to use the USB host application based on the HID class.	X	-	-	-
		HID_Standalone	This application shows how to use the USB host application based on the HID class.	X	-	-	-
		MSC_RTOS	This application shows how to use the USB host application based on the Mass Storage Class (MSC).	X	-	-	-
		MSC_Standalone	This application shows how to use the USB host application based on the Mass Storage Class (MSC).	X	-	-	-
Total number of applications: 30				19	0	3	8
Total number of projects: 122				37	17	29	39

1 Revision history

Table 2. Document revision history

Date	Revision	Changes
06-Jul-2015	1	Initial release.