AN3364
Application note

Migration and compatibility guidelines for STM32 microcontroller applications

1 Introduction

For designers of STM32 microcontroller applications, it is important to be able to easily replace one microcontroller type by another one in the same product series. Migrating an application to a different microcontroller is often needed, when product requirements grow, putting extra demands on memory size, or increasing the number of I/Os. On the other hand, cost reduction objectives may force you to switch to smaller components and shrink the PCB area. This application note is written to help you and analyze the steps you need to migrate from an existing STM32-based design to any one of the other microcontroller types in the fast-growing STM32 series.

To save your time, this application note groups together all the most important information and lists the vital aspects that you need to address.

All the information included here can also be extremely worthwhile in your first STM32 design, not immediately concerned by a migration project. Studying the issues now will help you tackle any future requirement by designing for compatibility from the beginning. To use this application note, general STM32 knowledge is required, you can learn it from the STM32 series reference manual, the STM32 datasheets, and the STM32 Flash program memory programming manuals.

This application note presents an overview of the whole STM32 series and presents a first level view of the different aspects that are important to consider when planning a new design or migrating. The microcontroller blocks and peripherals are grouped and identified either as fully compatible or compatible with enhancements or presented by types of series.

However the details of the migration guidelines across STM32 series are documented in separate documents. Please refer to either of the following two documents:

● AN3427 *Migrating applications from STM32F1 series to STM32F2 series*
● AN3422 *Migrating applications from STM32F1 series to STM32L1 series*.

Contents

2 How to migrate across STM32 series

2.1 STM32 series general overview

The STM32 platform forms a strong foundation with a broad and growing portfolio. With new products addressing new applications, the complete STM32 product series now comprises three series, **STM32F-1, STM32F-2 and STM32L-1,** each dedicated to a specific segment:

● *STM32 F-1*: The general-purpose F-1 series addresses a wide range of applications, from the lowest, price-sensitive designs to computing-intensive, high memory footprint ones.

The F-1 series is a complete series whose members are fully pin-to-pin, software and feature compatible.

– **Low-density** devices are STM32F101xx and STM32F103xx microcontrollers where the Flash memory density ranges between 16 and 32 Kbytes.

– **Medium-density** devices are STM32F101xx and STM32F103xx microcontrollers where the Flash memory density ranges between 32 and 128 Kbytes.

– **High-density** devices are STM32F101xx and STM32F103xx microcontrollers where the Flash memory density ranges between 256 and 512 Kbytes.

– **XL-density** devices are STM32F101xx and STM32F103xx microcontrollers where the Flash memory density ranges between 768 Kbytes and 1024 Kbyte.

– **Connectivity-line** devices are STM32F105xx and STM32F107xx microcontrollers where the Flash memory density ranges between 64 and 256 Kbytes.

– **Medium-density value line** device is STM32F100xx microcontrollers where the Flash memory density ranges between 64 and 128 Kbytes

– **High-density value line** device is STM32F100xx microcontrollers where the Flash memory density ranges between 128 and 512 Kbytes.

● *STM32 F-2*: The F-2 series provides the highest performance for computing-intensive applications and advanced connectivity. The F2 series maintains compatibility with the F1 series.

● *STM32 L-1:* Designed for ultra-low-power applications that are energy-aware and seek to achieve the absolute lowest power consumption. The L-1 series maintains compatibility with the F1 series.

In the rest of this document (unless otherwise specified),

– the terms F1, STM32 F1 and STM32F10x are used to refer to the STM32 F-1 series

– the terms F2, STM32 F2 and STM32F2xx are used to refer to the STM32 F-2 series

– the terms L1, STM32 L1 and STM32L1xx are used to refer to the STM32 L-1 series

2.1.1 STM32 product series feature comparison

Table 1. STM32 series overview

Peripheral		STM32 F-1 Series	STM32 L-1 Series	STM32 F-2 Series
Core		Cortex-M3 r1p1 MPU in XL-density only	Cortex-M3 r2p0 w/ MPU	Cortex-M3 r2p0 w/ MPU
FLASH memory		16 / 32 / 64 / 128 / 256 / 384 / 512 / 768KB - 1 MB	64/128 KB	128 / 256 / 512 / 768 / 1024 KB
SRAM		6 / 10 / 20 / 24 / 32 / 48 / 64 / 96 KB	10/16 KB	64/96/128 KB + 4KB backup SRAM (can be used as EEPROM memory)
OTP		No	No	Yes (512 Bytes)
FSMC		Yes	No	Yes
Max CPU frequency		24 / 36 / 48 / 72 MHz depending on the product line used	32 MHz	120 MHz
Operating voltage		2.0 to 3.6 V	1.65 to 3.6 V	1.8[1] to 3.6 V
Bootloader [2]		*Connectivity Line:* USART1/2, CAN2, DFU (OTG FS Device) *Other product lines:* USART1	USART1/2	USART1/3, CAN2, DFU (OTG FS Device)
Timers	**Advanced**	up to 2	No	2
	General purpose	up to 4	3	4
	Basic	up to 2	2	2
	2 Channels	up to 2	1	2
	1 Channel	up to 4	2	4
RTC		Counter	Hardware calendar	Hardware calendar
COMs	**SPI(I2S)**	up to 3(2)	2	3(2)
	TI mode	No	No	Yes
	Max freq	up to 18 Mbits/s	up to16 Mbits/s	up to 15 or 30 Mbits/s
	Audio freq	8 kHz up to 96 kHz	No	8 kHz up to 192 kHz

Table 1.   STM32 series overview (continued)

	Peripheral	STM32 F-1 Series	STM32 L-1 Series	STM32 F-2 Series
COMs	**I2C**	up to 2	2	3
	Max freq	400 KHz	400 KHz	400 KHz
	USART	up to 3	3	4
	UART	up to 2	No	2
	Max baud rate	2.25 or 4.5 Mbit/s	up to 4 Mbit/s	3.75 or 7.5 Mbit/s
	USB	USB Device FS	USB Device FS	OTG FS
		OTG FS		OTG HS
	CAN	up to 2	No	2
	SDIO	1	No	1
	CEC	up to 1	No	No
	Ethernet MAC	Yes w/ HW IEEE 1588 v1	No	Yes w/ HW IEEE1588 v2
GPIOs		26/37/51/80/112	37/51/83	51/82/114/140
12 bit ADC		up to 3	1	3
Max Sampling freq		1 MSPS	1 MSPS	2 MSPS
Number of channels		10/16/21 channels	16/20/24 channels	16/24 Channels
12 bit DAC		2	2	2
Max Sampling freq		1 MS/s	1 MS/s	1 MS/s
Number of channels		2	2	2
DCMI		No	No	Yes
Crypto/hash processor		No	No	Yes DES, 3DES, AES 256-bit SHA-1, MD5, HMAC

Table 1. **STM32 series overview (continued)**

Peripheral	STM32 F-1 Series	STM32 L-1 Series	STM32 F-2 Series
RNG	No	No	Yes
Package	VFQFPN36		
	LQFP48	LQFP48	
	VFQFPN48	VFQFN48	
	LQFP64	LQFP64	LQFP64
		BGA64	
	WLCSP64		WLCSP64
	TFBGA64		
	LQFP100	LQFP100	LQFP100
	BGA100	BGA100	
	LFBGA100		
	LQFP144		LQFP144
	BGA144		
			UFBGA176

1. If IRROFF is set to VDD on STM32F20xx devices, this value can be lowered to 1.65 V when the device operates in a reduced temperature range.

2. For more information, please refer to application note AN2606 *STM32 microcontroller system memory boot mode*.

2.1.2 STM32 product cross-compatibility

The STM32 series embeds a set of peripherals which can be classed in three categories:

● The first category is for the peripherals which are by definition common to all products. Those peripherals are identical, so they have the same structure, registers and control bits. There is no need to perform any firmware change to keep the same functionality at the application level after migration. All the features and behavior remain the same.

● The second category is for the peripherals which are shared by all products but have only minor differences (in general to support new features), so migration from one product to another is very easy and does not need any significant new development effort.

● The third category is for peripherals which have been considerably changed from one product to another (new architecture, new features...). For this category of peripherals, migration will require new development at application level.

Table 2 below gives a general overview of this classification:

Table 2.   STM32 peripheral compatibility analysis F1 versus F2 series

Peripheral	F1 series	F2 series	Compatibility		
			Comments	**Pinout**	**SW compatibility**
FSMC	Yes	Yes	Same features	Identical	Full compatibility
WWDG	Yes	Yes	Same features	NA	Full compatibility
IWDG	Yes	Yes	Same features	NA	Full compatibility
DBGMCU	Yes	Yes	Same features	NA	Full compatibility
CRC	Yes	Yes	Same features	NA	Full compatibility
EXTI	Yes	Yes	Same features	Identical	Full compatibility
CAN	Yes	Yes	Same features	Identical	Full compatibility
PWR	Yes	Yes+	Enhancement	NA	Full compatibility for the same feature
RCC	Yes	Yes+	Enhancement	NA	Partial compatibility
SPI	Yes	Yes+	TI mode / Max baudrate	Identical	Full compatibility for the same feature
USART	Yes	Yes+	Limitation fix / Max baudrate / One Sample Bit / Oversampling by 8	Identical	Full compatibility for the same feature
I2C	Yes	Yes+	Limitation fix	Identical	Full compatibility for the same feature
TIM	Yes	Yes+	32-bit Counter in TIM2 and TIM5	Identical	Full compatibility for the same feature
DAC	Yes	Yes+	DMA underrun interrupt	Identical	Full compatibility for the same feature

Table 2. **STM32 peripheral compatibility analysis F1 versus F2 series (continued)**

| Peripheral	F1 series	F2 series	Compatibility		
			Comments	Pinout	SW compatibility
Ethernet	Yes	Yes+	IEEE1588 v2 / Enhanced DMA descriptor	Identical	Full compatibility for the same feature
SDIO	Yes	Yes+	Limitation fix	Identical	Full compatibility for the same feature
USB OTG FS	Yes	Yes+	- Dynamic trimming capability of SOF framing period in Host mode - Embeds a VBUS sensing control	Identical	Full compatibility for the same feature
RTC	Yes	Yes++	New peripheral	Identical for the same feature	Not compatible
ADC	Yes	Yes++	New peripheral	Identical for the same feature	Partial compatibility
FLASH	Yes	Yes++	New peripheral	NA	Not compatible
DMA	Yes	Yes++	New peripheral	NA	Not compatible
GPIO	Yes	Yes++	New peripheral	Identical	Not compatible
CEC	Yes	NA	NA	NA	NA
USB FS Device	Yes	NA	NA	NA	NA
Crypto/hash processor	NA	Yes	NA	NA	NA
RNG	NA	Yes	NA	NA	NA
DCMI	NA	Yes	NA	NA	NA
USB OTG HS	NA	Yes	NA	NA	NA
SYSCFG	NA	Yes	NA	NA	NA

Color key:

■ = New feature or new architecture (Yes++)

■ = Same feature, but specification change or enhancement (Yes+)

■ = Feature not available (NA)

Table 3.   STM32 peripheral compatibility analysis F1 versus L1 series

Peripheral	F1 series	L1 series	Compatibility		
			Comments	**Pinout**	**SW compatibility**
SPI	Yes+	Yes	No I2S in L1 series L1 vs. F1: limitation fix	Identical	Full compatibility
WWDG	Yes	Yes	Same features	NA	Full compatibility
IWDG	Yes	Yes	Same features	NA	Full compatibility
DBGMCU	Yes	Yes	Same features	NA	Full compatibility
CRC	Yes	Yes	Same features	NA	Full compatibility
EXTI	Yes	Yes	Same features	Identical	Full compatibility
USB FS Device	Yes	Yes	Same features	Identical	Full compatibility
DMA	Yes	Yes	Same features	NA	Full compatibility
TIM	Yes	Yes	Same features	Identical	Full compatibility
PWR	Yes	Yes+	Enhancement	NA	Full compatibility for the same feature
RCC	Yes	Yes+	Enhancement	NA	Partial compatibility
USART	Yes	Yes+	Limitation fix / One Sample Bit method / Oversampling by 8	Identical	Full compatibility
I2C	Yes	Yes+	Limitation fix	Identical	Full compatibility
DAC	Yes	Yes+	DMA underrun interrupt	Identical	Full compatibility
ADC	Yes	Yes++	New peripheral	Identical	Partial compatibility
RTC	Yes	Yes++	New peripheral	Identical for the same feature	Not compatible
FLASH	Yes	Yes++	New peripheral	NA	Not compatible
GPIO	Yes	Yes++	New peripheral	Identical	Not compatible
CAN	Yes	NA	NA	NA	NA
CEC	Yes	NA	NA	NA	NA
Ethernet	Yes	NA	NA	NA	NA
SDIO	Yes	NA	NA	NA	NA
FSMC	Yes	NA	NA	NA	NA
LCD glass	NA	Yes	NA	NA	NA

Table 3. **STM32 peripheral compatibility analysis F1 versus L1 series (continued)**

Peripheral	F1 series	L1 series	Compatibility		
			Comments	**Pinout**	**SW compatibility**
COMP	NA	Yes	NA	NA	NA
SYSCFG	NA	Yes	NA	NA	NA

Color key:

    = New feature or new architecture (Yes++)

    = Same feature, but specification change or enhancement (Yes+)

    = Feature not available (NA)

2.2 Software migration

Each STM32 series is supported by a complete range of high-end and low-cost evaluation, software, debugging and programming tools.

This complete line includes third-party solutions that come complete with an integrated development environment and in-circuit debugger/programmer featuring a JTAG application interface. Developers who are new to this series and the Cortex™ core can also benefit from the range of starter kits that are specially designed to help developers evaluate device features and start their own applications.

Thanks to ST firmware libraries and a comprehensive set of application notes, STM32 microcontrollers offer a complete software interface to reduce the time to market and keep the user code independent from hardware details. The state-of-the-art and highly efficient library of software drivers combined with extensive support for all major tool providers offers a fast route to best-fit and an optimized development process.

3 Revision history

Table 4.   Document revision history

Date	Revision	Changes
20-Jul-2011	1	Initial release

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