

## STM32F401/10/11/12/13

### High-performance Access lines



## STM32F4 Access lines: performance, less dynamic power, high integration, and rich connectivity for cost-conscious applications

### STILL AN STM32F4!

The STM32F4 Access lines. made of STM32F401, STM32F410. STM32F411, STM32F412 and STM32F413<sup>4</sup> MCUs, are the entry level devices of the STM32F4 series that target cost-conscious applications. They are the right proposal when you reach the limits of your Cortex-M0+/ M3 designs and look for more performance and integration. These lines implement STM32 Dynamic Efficiency™ technology and solve the challenge of offering less dynamic power and more performance with high integration and lower cost.

With a new Batch Acquisition Mode (BAM) that optimizes power consumption during sensor data batching, the STM32F4 Access lines take Dynamic Efficiency to a new level.

### **PERFORMANCE**

Up to 100 MHz  $f_{\text{CPU}}$  delivering 125 DMIPS/339 CoreMark performance executing from Flash memory, with 0-wait states using ST's ART Accelerator<sup>TM</sup>.

The DSP instructions and the floating point unit enhance the overall processing.

### **POWER EFFICIENCY**

ST's 90-nm process, ART Accelerator and dynamic power scaling enables the current consumption when executing from Flash memory to be as low as 89  $\mu$ A/MHz. In Stop mode, the power consumption can be as low as 6  $\mu$ A.

### **INTEGRATION**

STM32F4 Access lines devices carry from 128 Kbytes to 1.5 Mbyte of Flash memory and up to 320 Kbytes of SRAM.

Available packages range from 36 to 144 pins.

- 10x USARTs up to 12.5 Mbits/s
- Up to 5x SPI (mixed with I<sup>2</sup>S) up to 50 Mbit/s

- Up to 4x I<sup>2</sup>C up to 1 Mbits/s
- 1x SDIO up to 48 MHz and available on all packages<sup>1</sup>
- 1x USB 2.0 OTG full speed1
- Up to 2x full-duplex and 3x simplex I<sup>2</sup>S up to 32-bit/192 kHz
- Up to 3x CAN (2.0B Active)
- 12-bit ADC reaching 2.4 MSPS
- Up to 2x 12-bit DAC<sup>2</sup>
- True random number generator<sup>2</sup>
- Up to 18x 16- and 32-bit timers running at up to 100 MHz
- Flexible external static memory controller with up to 16-bit data bus: SRAM, PSRAM, NOR Flash memory<sup>3</sup>
- Dual mode Quad-SPI interface<sup>3</sup>
- LCD parallel interface, 8080/6800 modes<sup>3</sup>
- Up to 6x PDM interfaces, stereo microphone support<sup>3</sup>

Notes

1. except STM32F410 2. on STM32F410, F412 and F413 3. on STM32F412 and F413

### STM32F423 BLOCK DIAGRAM

### **System** Power supply 1.2 V regulator POR/PDR/PVD/BOR Xtal oscillators 32 kHz + 4 ~26 MHz Internal RC oscillators 32 kHz + 16 MHz **PLL Clock control** RTC/AWU SysTick timer 2x watchdogs (independent and window) Up to 114 I/Os Cyclic redundancy

# Control 10x 16-bit timer 2x 16-bit motor control PWM synchronized AC timer 2x 32-bit timer 1x LP timer

check (CRC)

96-bit unique ID

# ART Accelerator™ ARM® Cortex®-M4 CPU 100 MHz Floating point unit (FPU) Nested vector interrupt controller (NVIC) JTAG/SW debug/ETM Memory Protection Unit (MPU)

# APB bus 16-channel DMA with Enhanced Batch Acquisition Mode (BAM+) True random number generator (TRNG)

AHB-Lite bus matrix

Encryption
AES (128-/256-bit)

### Up to 1.5-Mbyte Flash memory

320-Kbyte SRAM

80-byte backup registers

512-byte OTP

### Connectivity

4x I<sup>2</sup>C (SMBus/PMBus)

4x USART, 6x UART LIN, smartcard, IrDA, modem control 5x SPI or 5x I<sup>2</sup>S

> (2x FD / 3x HD) SDIO

USB 2.0 OTG FS (LPM)

Dual Quad-SPI 3x CAN 2.0B

FMC 16-bit (NOR only)

1x DFSDM 4 ch / 2 filters 1x DFSDM 8 ch / 4 filters + Beamforming enhanced

1x SAI (Serial audio interface)

### Analog

1x 12-bit ADC 2.4 MSPS 12 channels / 0.41 μs

2x DAC

Temperature sensor

### **HARDWARE TOOLS**

#### **Nucleo boards**



NUCLEO-F401RE NUCLEO-F410RB NUCLEO-F411RE NUCLEO-F412ZG NUCLEO-F413ZH

www.st.com/stm32nucle

### **Discovery kits**







STM32F401C-DISCO STM32F411E-DISCO STM32F412G-DISCO STM32F413H-DISCO

www.st.com/stm32f4-discovery

### **SOFTWARE TOOLS**

In addition to the wide set of partners and ARM® ecosystem solutions, the STM32F4 Access lines benefit from dedicated tools and software including STM32CubeF4 embedded software (HAL, Low-Layer APIs and CMSIS (CORE, DSP, RTOS), and a set of USB, TCP/IP, file system, RTOS, and graphic middleware components) with examples running on STM32 Nucleo, discovery kits and evaluation boards.



### STM32F4 ACCESS LINES

ARM® Cortex®-M4 (DSP + FPU) – Up to 180 MHz	• USART, SPI, I <sup>2</sup> C	Product lines	FCPU (MHz)	Flash (Kbytes)	RAM (KB)	RUN current (µA/MHz)	STOP current (µA)	Small package (mm)	FSMC (NOR/ PSRAM/LCD support	QSPI	DFSDM	CAN 2.0B	DAC	TRNG	DMA Batch Acquisition Mode	USB 2.0 OTG FS
	• To and 32-bit differs	STM32F401	84	128 to 512	up to 96	Down to 128	Down to 10	Down to 3x3								•
	• 12-bit ADC (0.41 µs) • True Random Number	STM32F410	100	64 to 128	32	Down to 89	Down to 6	Down to 2.553x 2.579					•	•	BAM	-
	Generator  • Batch Acquisition Mode	STM32F411	100	256 to 512	128	Down to 100	Down to 12	Down to 3.034x 3.22							BAM	•
	• Low voltage 1.7 to 3.6 V	STM32F412	100	512 to 1024	256	Down to 112	Down to 18	Down to 3.653x 3.651	•	•	•	•		•	BAM	• +LPM¹
	• Temperature:	STM32F413 <sup>2</sup>	100	1024 to 1536	320	Down to 115	Down to 18	Down to 3.951x 4.039	•	•	•	•	•	•	BAM	• +LPM¹

Notes:

Link Power Management

 $2. \ \ \text{The same devices are also found with embedded HW AES encryption (128-/256-bit) named STM32F423}$ 

