STM32F40x/41x
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 MCUs, are the entry level devices of the STM32F4 series that target cost-conscious applications. 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 fCPU delivering 125 DMIPS/ 339 CoreMark performance executing from Flash memory, with 0-wait states using ST’s ART Accelerator™

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 µA/MHz. In Stop mode, the power consumption can be as low as 6 µA.

INTEGRATION
- Up to 1.5 Mbyte of Flash memory 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 I2S) up to 50 Mbit/s
- Up to 4x I2C up to 1 Mbits/s
- 1x SDIO up to 48 MHz
- 1x USB 2.0 OTG full speed
- Up to 2x full-duplex and 3x simplex I2S 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
- True random number generator
- Up to 16x 16- and 32-bit
- Flexible external static memory controller with up to 16-bit data bus: SRAM, PSRAM, NOR Flash memory

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STM32F423 BLOCK DIAGRAM

**System**
- Power supply: 1.2 V regulator
- POR/PDR/PVD/BOR
- XTAL oscillators: 32 kHz + 16 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 check (CRC)
- 96-bit unique ID

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

**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)

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

**Encryption**
- AES (128-/256-bit)

**Connectivity**
- 4x USB (SMBus/FMBus)
- 4x UART, 6x I2C, 2x LIN, smartcard, IrDA, modem control
- 5x SPI or 5x FS (2x FO / 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)
- Temperature sensor

**Up to 1.5-Mbyte Flash memory**
- 320-Kbyte SRAM
- 512-byte OTP

**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**

<table>
<thead>
<tr>
<th>Product</th>
<th>FPU (MHz)</th>
<th>Flash (Kbytes)</th>
<th>RAM (KB)</th>
<th>Flash rate (µA/MHz)</th>
<th>Small Package (mm)</th>
<th>μC/μC-LD</th>
<th>SPI</th>
<th>SDIO</th>
<th>CAN 2.0B</th>
<th>DAC</th>
<th>DMA/SADC</th>
<th>USB 2.0 OTG FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32F401</td>
<td>84</td>
<td>128 to 512</td>
<td>up to 96</td>
<td>Down to 128</td>
<td>Down to 10</td>
<td>Down to 3x3</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>STM32F410</td>
<td>100</td>
<td>64 to 128</td>
<td>32</td>
<td>Down to 89</td>
<td>Down to 6</td>
<td>2.553x 2.579</td>
<td>•</td>
<td>•</td>
<td>BAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F411</td>
<td>100</td>
<td>256 to 512</td>
<td>128</td>
<td>Down to 100</td>
<td>Down to 12</td>
<td>3.034x 3.22</td>
<td>BAM</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>STM32F412</td>
<td>100</td>
<td>512 to 1024</td>
<td>256</td>
<td>Down to 112</td>
<td>Down to 18</td>
<td>3.653x 3.651</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>BAM</td>
<td>+LPM</td>
</tr>
<tr>
<td>STM32F413</td>
<td>100</td>
<td>1024 to 1536</td>
<td>320</td>
<td>Down to 115</td>
<td>Down to 18</td>
<td>3.951x 4.039</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>BAM</td>
<td>+LPM</td>
</tr>
</tbody>
</table>

**Notes:**
1. Link Power Management
2. The same devices are also found with embedded HW AES encryption (128-/256-bit) named STM32F423

**Hardware Tools**
- **Nucleo boards**
  - NUCLEO-F401RE
  - NUCLEO-F401RB
  - NUCLEO-F411RE
  - NUCLEO-F412ZG
  - NUCLEO-F413ZH
- **Discovery kits**
  - STM32F411E-DISCO
  - STM32F412G-DISCO
  - STM32F413H-DISCO

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