STM32L4 MCU series

Excellence in ultra-low-power with performance
Key advantages of STM32L4 series

1. **ULP leader and performance booster** ST has built a new architecture to reach best-in-class, ultra-low-power figures thanks to its high flexibility. Moreover, the performance of the STM32L4 series adds a new dimension to the ultra-low-power world. It delivers 100 DMIPS based on its ARM Cortex-M4 core with FPU and ST ART Accelerator™ at 80 MHz.

2. **Innovation** To address a large market range, its architecture implements several innovations and embeds smart peripherals.

3. **Integration and safety** Up to 1 Mbyte of Flash memory and 128 Kbytes of SRAM with safety and security features, smart and numerous peripherals, advanced and low-power analog circuits in packages as small as 3.13 x 3.14 mm.

4. **Great Investment** This new STM32 member benefits from the pin-to-pin compatibility of the STM32 family and the STM32 development ecosystem.
Ultra-low-power and flexibility

STM32L4 is based on a new platform optimized to reduce power consumption and increase flexibility

- Down to 8 nA for I/O wake-up with additional Shutdown mode
- RTC available for all power modes (from Active down to V_{BAT})
- 2 nA V_{BAT} mode with charging capability Automatic switch to maintain power for RTC and backup registers
- USB crystal-less capable (Dedicated crystal oscillator is no longer needed for USB functions)
- Internal oscillator from 100 kHz to 48 MHz (±0.25% int. clock accuracy over voltage/temperature with LSE)
- External level shifter no longer needed Separate V_{DD} supplies (down to 1.08 V)
- Down to 200 nA keeping 16 Kbytes of SRAM active in Standby mode
- Wake up MCU with any peripheral (Communication I/Fs, analog circuits, timers …)
- I/O level kept in low-power modes Optimization of system consumption
- Optimization of system consumption
- STM32L4 ULP leader and performance booster
# Ultra-low-power modes

## Best power consumption numbers with full flexibility

<table>
<thead>
<tr>
<th>Wake-up time</th>
<th>VBAT</th>
<th>2 nA / 200 nA*</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 µs</td>
<td>Shutdown</td>
<td>8 nA / 200 nA*</td>
</tr>
<tr>
<td>14 µs</td>
<td>Standby</td>
<td>28 nA / 280 nA*</td>
</tr>
<tr>
<td>14 µs</td>
<td>Standby + 16-Kbyte RAM</td>
<td>200 nA / 450 nA*</td>
</tr>
<tr>
<td>5 µs</td>
<td>Stop 2 (full retention)</td>
<td>1.0 µA / 1.28 µA*</td>
</tr>
<tr>
<td>4 µs</td>
<td>Stop 1 (full retention)</td>
<td>4.3 µA / 4.7 µA*</td>
</tr>
<tr>
<td>6 cycles</td>
<td>Sleep</td>
<td>26 µA / MHz</td>
</tr>
<tr>
<td></td>
<td>Run at 24 MHz</td>
<td>84 µA / MHz</td>
</tr>
<tr>
<td></td>
<td>Run at 80 MHz</td>
<td>102 µA / MHz</td>
</tr>
</tbody>
</table>

**Note:** * without RTC / with RTC

- **Tamper detection:** 3 I/Os, RTC
- **Wake-up sources:** reset pin, 5 I/Os, RTC
  
  - Wake-up sources: + BOR, IWDG
  - Wake-up sources: + all I/Os, PVD, LCD, COMPs, I²C, LPUART, LPTIM
  - Wake-up sources: + all I²C, UART
  - Wake-up sources: any interrupt or event
The higher the better!

On competition devices: discontinuity due to DC/DC no longer functional when voltage decreases
Providing more performance

Do not compromise on performance with STM32L4

- Up to 80 MHz/100 DMIPS with ART Accelerator™
- Up to 273 CoreMark result
- ARM Cortex-M4 with FPU and DSP instructions
- 2x DMA (14 channels)
- SPI up to 40 Mbit/s, USART 10 Mbit/s

Execution performance from Flash memory

CoreMark score

Linear performance thanks to ST ART Accelerator™

CPU frequency

80 MHz

Competitors: impact of wait states
**Digital Filter for Sigma Delta Modulators**
8 x parallel inputs with up to 24-bit data output resolution

**V\textsubscript{\text{BAT}} with RTC**
for battery backup
200 nA in V\textsubscript{\text{BAT}} mode for RTC and 32 x 32-bit backup registers

**TRNG & AES**
for Security
128-/256-bit AES key encryption hardware accelerator

**FSMC**
External memory interface for static memories supporting SRAM, PSRAM, NOR and NAND

**STM32L4**
Electricity/Gas/Water Smart Meter

**SPI / UART/ SDIO for Wireless**
3x SPIs (4x SPIs with the Quad-SPI)
6x USARTs (ISO 7816, LIN, IrDA, modem)
1 x SDIO

**I/Os**
Up to 114 fast I/Os for buttons & relays

**Anti-tamper pin**
3 x tamper-detection pins for battery domain

**LCD Display**
38x40 or 4x44 with step-up converter

**smart peripherals**

**Δ Metering**
Smart peripherals

Fitness tracker - Wristband

STM32L

Digital Filter for Sigma Delta Modulators
with PDM (Pulse Density Modulation) microphone input support

Sensors

Batch Acquisition Mode (BAM)

SPI / UART
3x SPIs (4x SPIs with the Quad-SPI)
6x USARTs (ISO 7816, LIN, IrDA, modem)

SWP
Single wire protocol master interface (SWPMI)

STM32L

I²C
3x I²C FM+(1 Mbit/s), SMBus/PMBus

BAM

OPAMP
2x op amp with built-in PGA

DAC
2x 12-bit DAC, low-power sample and hold

ADC
3x 12-bit ADC 5 MSPS, up to 16-bit with hardware oversampling, 200 μA/MSPS

TFT Display

FSMC
Parallel interface to TFT SPI
Up to 40 MHz speed

USB
USB OTG 2.0 full-speed, LPM and BCD

SAI
2x serial audio interfaces

Innovation
**Motor control**:
2x 16-bit advanced motor-control timers

3x 12-bit ADCs: 5 MSPS, with up to 16-bit with hardware oversampling, 200 μA/MSPS

**Industrial sensors**

**STM32L4**

- **CAN Bus** (2.0B Active)
- **TRNG & AES** for Security
  128/256-bit AES key encryption hardware accelerator
- **FSMC**
  External memory interface for static memories
  supporting SRAM, PSRAM, NOR and NAND
- **I/Os**
  Up to 114 GPIOs
- **I²C**
  3x I²C FM+(1 Mbit/s), SMBus/PMBus
- **SPI / UART**
  3x SPIs (4x SPIs with the Quad-SPI)
  6x USARTs (ISO 7816, LIN, IrDA, modem)
- **LCD Display**
  8x40 or 4x44 with step-up converter
- **High temperature**
  from -40°C up to +125°C
High integration with high memory size in small packages

Parallel Interface
- FSMC 8-/16-bit (TFT-LCD, SRAM, NOR, NAND)

Display
- 8 x 40 LCD driver

Timers
- 17 timers including:
  - 2 x 16-bit advanced motor control timers
  - 2 x ULP timers
  - 7 x 16-bit timers
  - 2 x 32-bit timers

I/Os
- Up to 114 I/Os
  - Touch-sensing controller

ARM® Cortex®-M4
- 80 MHz
- FPU
- MPU
- ETM
- DMA

ART Accelerator™
- Up to 1-Mbyte Dual Bank Flash memory with ECC

Connectivity
- USB OTG,
  - 1x SD/SDIO/MMC, 3 x SPI,
  - 3 x I²C, 1x CAN, 1 x Quad-SPI,
  - 5 x USART + 1 x ULP UART,
  - 1 x SWP

Digital
- AES (256-bit), TRNG, 2 x SAI, DFSDM (8 channels)

Analog
- 3 x 16-bit ADC, 2 x DAC,
  - 2 x comparators, 2 x op amps
  - 1 x temperature sensor

Package size down to 3.13 x 3.14 mm
Safety and security

Integrated safety and security features

**SAFETY**
- Brown-out reset in all modes
- Clock security system
- SRAM parity check
- Backup byte registers
- Supply monitoring
- Flash memory with ECC with status register (address)
- Dual watchdog

**SECURITY**
- Anti-tamper detection
- Memory Protection Unit (MPU)
- Read and Write Protection
- Unique ID
- AES-256 encryption
- JTAG fuse
- True random number generator
- Software IP protection
STM32L4: continuity in STM32 portfolio

9 product series / more than 32 product lines
STM32L4 benefits from pin-to-pin compatibility across the family

<table>
<thead>
<tr>
<th></th>
<th>High-performance</th>
<th>Mainstream</th>
<th>Ultra-low-power</th>
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<tbody>
<tr>
<td>CoreMark</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>398</td>
<td>120 MHz 150 DMIPS</td>
<td>177</td>
<td>75</td>
</tr>
<tr>
<td>608</td>
<td>180 MHz 225 DMIPS</td>
<td>106 CoreMark</td>
<td>32 MHz 26 DMIPS</td>
</tr>
<tr>
<td>1082</td>
<td>216 MHz 462 DMIPS</td>
<td>245 CoreMark*</td>
<td>32 MHz 33 DMIPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>273 CoreMark</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>72 MHz 90 DMIPS</td>
<td>80 MHz 100 DMIPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(*) from CCM-SRAM</td>
<td></td>
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</tbody>
</table>

Cortex-M0
Cortex-M0+
Cortex-M3
Cortex-M4
Cortex-M7

Great investment
STM32L ULP porfolio

STM32L4 completes the ultra-low-power family

**Cost-smart ULP champion**
Cortex-M0+ at 32 MHz
1.65 to 3.6V
8-/16-bit applications
Wide range of pin-counts

3 product lines, Cost-effective, Smaller packages, USB, LCD, Analog
16 to 192 Kbytes of Flash, 20 Kbytes of SRAM

**Broad-range foundation**
Cortex-M3 at 32 MHz
1.65 to 3.6V
Wide choice of memory sizes

3 product lines, USB, LCD, AES, Rich Analog True EEPROM, Dual-bank Flash memory (RWW), 32 to 512 Kbytes of Flash, 80 Kbytes of SRAM

**High-performance Advanced analog**
Cortex-M4 w/ FPU at 80 MHz
1.71 to 3.6V
High-performance, advanced analog circuits

3 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, LCD, AES
128 Kbytes to 1 Mbyte
128 Kbytes of SRAM

Great investment
STM32L4 portfolio

Legend:
- With 128/256-bit AES hardware encryption
- Without encryption
STM32L4 ecosystem

HARDWARE TOOLS

- STM32 Nucleo
  - Flexible prototyping

- Discovery kit
  - Key feature prototyping

- Evaluation board
  - Full feature evaluation

SOFTWARE TOOLS

- STM32CubeMX featuring code generation and power consumption calculation

Great investment
STM32L4 ecosystem

EMBEDDED SOFTWARE

- Open-source TCP/IP stack (lwIP)
- USB Host and Device library from ST
- STemWin graphical stack library from ST and SEGGER
- Open-source FAT file system (FatFs)
- Open-source real-time OS (FreeRTOS)
- Touch-sensing library
- Dozens of examples

- STM32L4 Hardware Abstraction Layer (HAL) portable APIs
- High-performance, light-weight low-layer (LL) APIs
- High coverage for most STM32 peripherals
- Production-ready and fully qualified
- Dozens of usage examples
- Open-source BSD license
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**Mbed.org**

**STM32 @ ARM connected community**

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Thank you

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