STM32L4+ MCU series
Excellence in ultra-low-power with more performance
Key messages of STM32 L4+ series

More performance and still ULP leader ST has stretched the STM32L4 architecture to reach 150 MIPS based on its ARM Cortex-M4 core with FPU and ST ART Accelerator™ at 120 MHz while keeping best-in-class, ultra-low-power (ULP) figures.

More Graphics and Innovation Enhanced graphics acceleration and innovative peripherals are embedded to optimize the BOM cost.

More Integration 2 MB of Flash and 640 KB of SRAM with safety and security features, smart and numerous peripherals, advanced and low power analog circuits in packages as small as 5.2 x 5.2 mm.

Great Investment This new STM32 member benefits from the pin-to-pin compatibility of the STM32 family and the STM32 Ecosystem.
Providing more performance

Stretching the performance and still excellent in Power consumption

- Up to 120 MHz/150 DMIPS with ART Accelerator™
- Up to 410 CoreMark Result
- ARM Cortex-M4 with DSP instructions and floating-point unit (FPU)
- 2 x DMA (14 channels)
- SPI up to 60 Mbit/s, OctoSPI up to 86 MHz USART up to 10 Mbit/s,
Ultra-low-power leader

EEMBC ULPBench leader

ULPMark-CP at 3.0V

ULPMark-CP at 1.8V

ULPMark-PP at 3.0V

ULPMark-PP at 1.8V

More performance and still ULP leader
### Ultra-low-power modes

**Best power consumption numbers with full flexibility**

<table>
<thead>
<tr>
<th>Wake-up Time</th>
<th>VBAT</th>
<th>3 nA / 300 nA*</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 µs</td>
<td>Shutdown</td>
<td>33 nA / 300 nA*</td>
</tr>
<tr>
<td>14 µs</td>
<td>Standby</td>
<td>125 nA / 480 nA*</td>
</tr>
<tr>
<td>14 µs</td>
<td>Standby + 64-Kbyte RAM</td>
<td>500 nA / 800 nA*</td>
</tr>
<tr>
<td>5 µs</td>
<td>Stop 2 (retention: 256-Kbyte RAM)</td>
<td>2.5 µA / 2.9 µA*</td>
</tr>
<tr>
<td>5 µs</td>
<td>Stop 2 (full retention: 640-Kbyte RAM)</td>
<td>3.9 µA / 4.3 µA*</td>
</tr>
<tr>
<td>6 cycles</td>
<td>Sleep</td>
<td>13 µA / MHz**</td>
</tr>
<tr>
<td></td>
<td>Run up to 120 MHz</td>
<td>Down to 43 µA / MHz**</td>
</tr>
</tbody>
</table>

**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:** any interrupt or event

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**Note:**
- * without RTC / with RTC
- ** with external SMPS

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More performance and still ULP leader
STM32L4+ keeps the advantages of the great STM32L4 platform optimized to reduce power consumption and increase flexibility.

- External level shifter no longer needed. Separate $V_{DD}$ supplies (down to 1.08 V).
- Down to 33 nA for I/O wake-up with additional Shutdown mode.
- RTC available for all power modes (from Active down to $V_{BAT}$).
- Down to 500 nA keeping 64 Kbytes of SRAM active in Standby mode.
- 3 nA $V_{BAT}$ mode with charging capability. Automatic switch to maintain power for RTC and backup registers.
- Wake up MCU with any peripheral (Communication I/Fs, analog circuits, timers …)
- USB crystal-less capable. (Dedicated crystal oscillator is no longer needed for USB functions).
- I/O level kept in low-power modes. Optimization of system consumption.
- Internal oscillator from 100 kHz to 48 MHz ($\pm 0.25\%$ int. clock accuracy over voltage/temperature with LSE).

More performance and still ULP leader.
Efficient run and fast wake-up

Ready for Launch Control? From 0 to 48 MHz in less than 5 µs

- Thanks to our internal oscillator (MSI) used at start-up (programmable from 100 kHz to 48 MHz)
- PLL wake-up time < 15 µs (needed to reach $f_{\text{MAX}}$)
- No inrush current

< 5 µs!
Enhanced Graphics Capabilities

- Chrom-ART Accelerator™
  - 2D Graphic acceleration
  - Allowing enhanced graphic while releasing the core capabilities for real time processing

11% CPU Load
With chrom-ART Accelerator and 84% CPU load without it
Enhanced Graphics Capabilities

• Chrom-ART Accelerator™

• Large choice of display interfaces
  • MIPI-DSI Controller for high pixel density, low pin count and low EMI displays
  • LCD-TFT Controller for mid resolution displays
  • Parallel display interface for low resolution displays
Enhanced Graphics Capabilities

- Chrom-ART Accelerator™
- Large choice of display interfaces
- Integration and resources optimization
  - Chrom-GRC™ memory optimization for round displays
  - Large internal SRAM allowing
    - BOM cost and power consumption optimization
    - Support of up to 400x400 24 bpp MIPI-DSI round displays
    - Support of up to 4”, WQVGA 16 bpp TFT displays with no external memory
Digital Smart Peripherals

- **Peripherals running in Stop mode**
  - Low-power UART can wake up the system if a programmed byte or start bit is detected (with no loss of the first bit)
  - I²C can wake up system when address is detected
  - Low-power timer can count time or events or generate signals

- **2x Octo SPI for data and execution in place**
  - External Flash and SRAM support
  - Single, dual, quad and Octo SPI and Hyperbus

- **Digital Filter for Sigma Delta Modulator**
  - For connection to external sigma delta modulator (e.g.: STPMS2)
  - Up to 4 filters, 8 multiplexed channels
  - Also supports digital microphone MEMs (PDM to PCM conversion and filtering performed by HW)

- **Peripheral clock independent from main system clock**
Analog Smart Peripherals

- 12/16-bit ADC (up to 5 Msps)
  - Adaptive power consumption (200µA/Msps)
  - HW oversampling
  - Single and differential inputs

- 2x Op amps with built-in PGA

- 2 x 12-bit DACs (1 Msps)
  - Low-power Sample and Hold modes available in Stop mode

- 2x Comparators
  - Low-power modes, works in Stop mode

- Internal voltage reference
  - Programmable 2.048 or 2.5 V
  - Can be used for external components

More Graphics and Innovation
**Smart peripherals**

**STM32L4+**

- **Digital Filter for Sigma Delta Modulators**
  - 8 x parallel inputs with up to 24-bit data output resolution

- **V_{BAT} with RTC**
  - for battery backup
  - 300 nA in V_{BAT} mode for RTC and 32x 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

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

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

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

- **LCD Display**
  - SPI, Parallel or TFT Interface

- **Electricity/Gas/Water Smart Meter**

**More Graphics and Innovation**
Smart peripherals

Fitness tracker - Wristband

STM32L4+

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

- **Batch Acquisition Mode (BAM)**

- **I²C**
  - 3x I²C FM+(1 Mbit/s), SMBus/PMBus

- **Sensors**

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

- **USB**
  - USB OTG 2.0
  - full-speed, LPM and BCD

- **SAI**
  - 2x serial audio interfaces

- **STM32L4+ FSMC**
  - Parallel interface to TFT
  - SPI
  - Up to 60 MHz speed
  - MIPI DSI
  - Direct connection
  - Chrom-ART
  - Graphic Acceleration
  - Chrom-GRC
  - SRAM needs reduction

- **Display**
  - FSRC
  - Parallel interface to TFT
  - SPI
  - Up to 60 MHz speed
  - MIPI DSI
  - Direct connection
  - Chrom-ART
  - Graphic Acceleration
  - Chrom-GRC
  - SRAM needs reduction

- **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

More Graphics and Innovation
Smart Peripherals
Industrial Sensors

Motor Control:
- 2x 16-bit advanced motor-control timers
- 12-bit ADCs: 5 MSPS, with up to 16-bit with hardware oversampling, 200 µA/MSPS

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

Display
TFT controller, or SPI or FSMC

High temperature
from -40°C up to +125°C

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

I²C
- 3x I²C FM+(1 Mbit/s), SMBus/PMBus
- More Graphics and Innovation

STM32L4+

I/Os
Up to 114 GPIOs
High integration

High integration with high memory size in small packages

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

**Display**
- DSI MIPI
- LCD TFT Controller

**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 136 I/Os
- Touch-sensing controller

**Cortex-M4**
- 120 MHz
- FPU
- MPU
- ETM
- DMA
- ART Accelerator™
- Chrom-ART Accelerator™
- Up to 2-Mbyte Flash with ECC Dual Bank
- 640-Kbyte RAM

**Connectivity**
- USB OTG Crystal less,
  - 1x SD/SDIO/MMC, 3 x SPI,
  - 4 x I²C, 1x CAN, 2 x Octo SPI,
  - 5 x USART + 1 x ULP UART

**Digital**
- AES (256-bit), SHA (256-bit),
  - TRNG, 2 x SAI, DFSDM (8 channels),
  - Camera I/F, Chrom-GRC™

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

Package size down to 5.24 x 5.24 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 with ECC with status register (address)
- Dual watchdog

**SECURITY**
- Anti-tamper detection
- Memory Protection Unit (MPU)
- Read and Write Protection
- Unique ID
- AES-256 / SHA-256 Encryption
- JTAG fuse
- True Random Number Generator
- Software IP Protection
- OTP Zone

**STM32 L4+**
STM32L4+: continuity in STM32 portfolio

11 product series / more than 800 part numbers
STM32L4+ benefits from pin-to-pin compatibility across the family

<table>
<thead>
<tr>
<th></th>
<th>CoreMark</th>
<th>Frequency</th>
<th>DMIPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>398</td>
<td>120 MHz</td>
<td>150 DMIPS</td>
</tr>
<tr>
<td></td>
<td>608</td>
<td>180 MHz</td>
<td>225 DMIPS</td>
</tr>
<tr>
<td></td>
<td>1 082</td>
<td>216 MHz</td>
<td>462 DMIPS</td>
</tr>
<tr>
<td>Mainstream</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>48 MHz</td>
<td>36 DMIPS</td>
</tr>
<tr>
<td></td>
<td>177</td>
<td>72 MHz</td>
<td>61 DMIPS</td>
</tr>
<tr>
<td></td>
<td>245</td>
<td>90 MHz</td>
<td>90 DMIPS</td>
</tr>
<tr>
<td></td>
<td>2 020</td>
<td>400 MHz</td>
<td>856 DMIPS</td>
</tr>
<tr>
<td>Ultra-low-power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>32 MHz</td>
<td>26 DMIPS</td>
</tr>
<tr>
<td></td>
<td>93</td>
<td>32 MHz</td>
<td>33 DMIPS</td>
</tr>
<tr>
<td></td>
<td>273</td>
<td>80 MHz</td>
<td>100 DMIPS</td>
</tr>
<tr>
<td></td>
<td>409</td>
<td>120 MHz</td>
<td>150 DMIPS</td>
</tr>
</tbody>
</table>

* from CCM-SRAM

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

Great investment
### STM32L ULP portfolio

<table>
<thead>
<tr>
<th>Cost-smart ULP champion</th>
<th>Broad-range foundation</th>
<th>ULP with Performance</th>
<th>ULP with More Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STM32 L0</strong></td>
<td><strong>STM32 L1</strong></td>
<td><strong>STM32 L4</strong></td>
<td><strong>STM32 L4+</strong></td>
</tr>
<tr>
<td>Cortex-M0+ at 32 MHz 1.65 to 3.6V 8/16-bit applications Wide range of pin-counts</td>
<td>Cortex-M3 at 32 MHz 1.65 to 3.6V Wide choice of memory sizes</td>
<td>5 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, LCD, AES 128 to 1 Mbyte of Flash Up to 320 Kbytes of SRAM</td>
<td>Cortex-M4 w/ FPU at 80 MHz 1.71 to 3.6V Performance, advanced analog circuits 3 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, Graphics, AES 1 to 2 Mbyte of Flash 640 Kbytes of SRAM</td>
</tr>
</tbody>
</table>

- 3 product lines, Cost-effective, Smaller packages, USB, LCD, Analog 8 to 192 Kbytes of Flash, 20 Kbytes of SRAM
- 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
- 5 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, LCD, AES 128 to 1 Mbyte of Flash Up to 320 Kbytes of SRAM

- STM32L4+ completes the ultra-low-power family

- STM32L4+ is the ULP with More Performance.
### STM32L4+, a complete offer

**STM32L4+ completes the ultra-low-power family**

<table>
<thead>
<tr>
<th>Flash size (bytes)</th>
<th>Pins</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 K</td>
<td>20</td>
</tr>
<tr>
<td>16 K</td>
<td>28</td>
</tr>
<tr>
<td>32 K</td>
<td>32</td>
</tr>
<tr>
<td>64 K</td>
<td>48</td>
</tr>
<tr>
<td>128 K</td>
<td>64</td>
</tr>
<tr>
<td>256 K</td>
<td>96</td>
</tr>
<tr>
<td>512 K</td>
<td>120</td>
</tr>
<tr>
<td>1 M</td>
<td>144</td>
</tr>
<tr>
<td>2 M</td>
<td>169</td>
</tr>
</tbody>
</table>

**More performance**

- **STM32L0**
  - 26 DMIPS
  - 75 CoreMark
  - Flash size: 8 K
- **STM32L1**
  - 33 DMIPS
  - 93 CoreMark
  - Flash size: 16 K
- **STM32L4**
  - 100 DMIPS
  - 273 CoreMark
  - Flash size: 32 K
- **STM32L4+**
  - 150 DMIPS
  - 409 CoreMark
  - Flash size: 1 M

**More memory and pin counts**

**More packages**

- WLCSP
- QFN
- LQFP
- BGA

**Great investment**
### STM32L4+ series

**STM32L4R5/S5 - Access lines**

<table>
<thead>
<tr>
<th>Product line</th>
<th>FLASH (KB)</th>
<th>RAM (KB)</th>
<th>Memory I/F</th>
<th>2 x Op-Amp</th>
<th>2 x Comp.</th>
<th>8ch / 4x Sigma Delta Interface</th>
<th>12-bit ADC 5 Mbps 16 bit HW oversampling</th>
<th>USB2.0 OTG FS</th>
<th>MIPI DSI</th>
<th>TFT Display Interface</th>
<th>Chrom-GRCTM</th>
<th>AES 128/256-bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32L4R5</td>
<td>2048 to 1024</td>
<td>640</td>
<td>SDIO FSMC</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32L4S5</td>
<td>2048</td>
<td>640</td>
<td>SDIO FSMC</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STM32L4R7/S7 with TFT interface**

<table>
<thead>
<tr>
<th>Product line</th>
<th>FLASH (KB)</th>
<th>RAM (KB)</th>
<th>Memory I/F</th>
<th>2 x Op-Amp</th>
<th>2 x Comp.</th>
<th>8ch / 4x Sigma Delta Interface</th>
<th>12-bit ADC 5 Mbps 16 bit HW oversampling</th>
<th>USB2.0 OTG FS</th>
<th>MIPI DSI</th>
<th>TFT Display Interface</th>
<th>Chrom-GRCTM</th>
<th>AES 128/256-bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32L4R7</td>
<td>2048 to 1024</td>
<td>640</td>
<td>SDIO FSMC</td>
<td>●</td>
<td>●</td>
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<td>1</td>
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<td>●</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>STM32L4AS7</td>
<td>2048</td>
<td>640</td>
<td>SDIO FSMC</td>
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<td>●</td>
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<td>1</td>
<td>●</td>
<td>●</td>
<td></td>
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</tr>
</tbody>
</table>

**STM32L4R9/S9 with MIPI-DSI and with TFT interface**

<table>
<thead>
<tr>
<th>Product line</th>
<th>FLASH (KB)</th>
<th>RAM (KB)</th>
<th>Memory I/F</th>
<th>2 x Op-Amp</th>
<th>2 x Comp.</th>
<th>8ch / 4x Sigma Delta Interface</th>
<th>12-bit ADC 5 Mbps 16 bit HW oversampling</th>
<th>USB2.0 OTG FS</th>
<th>MIPI DSI</th>
<th>TFT Display Interface</th>
<th>Chrom-GRCTM</th>
<th>AES 128/256-bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32L4R9</td>
<td>2048 to 1024</td>
<td>640</td>
<td>SDIO FSMC</td>
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<td>●</td>
<td>●</td>
<td>1</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32L4AS9</td>
<td>2048</td>
<td>640</td>
<td>SDIO FSMC</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- ART Accelerator™
- USART, SPI, I²C
- 2 x Quad-SPI
- 16 and 32-bit timers
- SA1 + audio PLL
- CAN
- Camera IF
- Chrom-ART Accelerator™
- 2x 12-bit DAC
- Temperature sensor
- Low voltage 1.71V to 3.6V
- $V_{BAT}$ Mode
- Unique ID
- Capacitive Touch sensing
- + Great investment
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/L4+ ecosystem

**EMBEDDED SOFTWARE**

- 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

- 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)
- Numerous examples

STM32CubeL4

- Low-level drivers

STM32CubeL4

- Middleware

User code

+ Great investment
STM32 Graphic ecosystem

3 Recommended Software Solutions

Entry Solution

Advanced Solutions

STMWin

TouchGFX

Embedded Wizard

FREE

Great investment
Summary

4 Keys of STM32 L4 + series

+ More performance and still ULP leader
+ More Graphics and Innovation
+ More Integration
+ Great Investment
Thank you