STM32H7
World Most Powerful MCU

Marketing Presentation
Continuing the STM32 Success Story

Leader in Arm Cortex©-M 32-bit General Purpose MCU

- 1st Mixed Signal DSP + Analog STM32F3 Cortex-M4
- 1st High Perf. Cortex-M4 168 MHz
- Entry Cost Ultra-low-power STM32F0 Cortex-M0
- World 1st High Perf. Cortex-M7
- Leadership Ultra-low-power Cortex-M4
- #1 ULP 447 ULPBench™
- #1 Performance 3224 CoreMark
- Ultra-low-power Excellence
- Dual-core, multiprotocol and open radio
- Mainstream Cortex-M0+ MCUs Efficiency at its best!
- Introduction of M33 Excellence in ULP with more security
- World’s Most Powerful MCU
- Expanding H7 series
- Dual-core Microprocessor among the STM32
- The world’s first LoRa® enabled System-on-Chip

STM32H7 Series

New product lines expanding the STM32 portfolio

New Performance Record
2424 + 800 CoreMark (Cortex©-M7 @480 MHz + Cortex©-M4 @240 MHz)

Single and Dual-core flexible architecture for industrial, security or AI applications
Accelerated graphics, fast data transfer, advanced peripherals

Advanced security features
Crypto Hash, Cortex©-M7 STM32Trust security ecosystem

Rich eco-system to speed-up your design
SW tools, HW boards, community and partners
Performance Record
High-Performance Range

Arm® Cortex®-M7 @480MHz
Most powerful Cortex core with double precision FPU, MPU, advanced DSP and L1 cache

Arm® Cortex®-M4 @240MHz
Best in class core for real-time with single precision FPU, DSP, MPU and ART Accelerator™
Extend the STM32H7 Experience

Dual core lines for concurrent-thread-applications

Single core lines for single-thread-application

arm Cortex-M7

arm Cortex-M4
### Dual-core Line

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Frequency</th>
<th>Core</th>
<th>RAM</th>
<th>Flash</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32H7A3/B3</td>
<td>280 MHz</td>
<td>Cortex®-M7</td>
<td>1.4 MB</td>
<td>Flash up to 2 MB</td>
</tr>
</tbody>
</table>

### Single-core Line

<table>
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<tr>
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<th>Frequency</th>
<th>Core</th>
<th>RAM</th>
<th>Flash</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32H742</td>
<td>480 MHz</td>
<td>Cortex®-M7</td>
<td>1027 DMIPS</td>
<td>Flash up to 2 MB</td>
</tr>
<tr>
<td>STM32H743/753</td>
<td>480 MHz</td>
<td>Cortex®-M7 &amp; M4</td>
<td>1027 DMIPS</td>
<td>Flash up to 2 MB</td>
</tr>
</tbody>
</table>

### Value Line

<table>
<thead>
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<th>Frequency</th>
<th>Core</th>
<th>RAM</th>
<th>Flash</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32H7B0</td>
<td>280 MHz</td>
<td>Cortex®-M7</td>
<td>1.4 MB</td>
<td>Flash up to 128 KB</td>
</tr>
<tr>
<td>STM32H750</td>
<td>480 MHz</td>
<td>Cortex®-M7 &amp; M4</td>
<td>1027 DMIPS</td>
<td>Flash up to 128 KB</td>
</tr>
</tbody>
</table>

*Arm® Cortex® core*
Powerful Cores
Supported by a Powerful Architecture

Display nice graphic
The Chrom-ART Accelerator and MJPEG codec offload the CPU by more than 90%

Transfer data efficiently across peripherals
The Main DMA takes care of the most complex schemes between memories and peripherals with up to 16 channels to offload the CPU

Manage security
Use dedicated cryptography and Hashing HW acceleration to offload the CPU by more than 90%

Generate complex wave forms
High-Resolution timer (2.1ns) can generate complex wave forms synchronized on multiples events, with no CPU assist
Dual-core Architecture Approach

2 Simple Examples

Industrial tool machine

**Cortex-M7** = HMI
**Cortex-M4** = Com/Gateway + Motor Control + Sensor pre-processing (AI)

Home automation & security

**Cortex-M7** = AI NN (Pattern recognition, ASR)
**Cortex-M4** = Com/Gateway + Real-time I/F
Build Complex Applications
Mixing AI and Real-time Control

Connected Kitchen Aid with advanced HMI (Large display and Voice recognition)
Benefits of Dual-core Architecture

Increase system performance
- 2x processing units working in parallel (2 applications or run time safety check by 1 core)
- Reduces computation time and average power consumption

Increase system efficiency
Workload balance between 3 power domains
- Cortex-M7 (more powerful): GUI, DSP, security
- Cortex-M4 (real-time): Connectivity, RTOS, Motor control or process control task
- Batch Acquisition Mode domain: sensors acquisition, GPIO and low power management

Reduce development time
- Reduce dependencies between dev. Teams (one team per core)
- Less components on the PCB to ease and shorten PCB design and validation

Reduce system cost
Reduce BOM cost by transferring more tasks to STM32H7
- Remove external devices (by integrating secondary functions)
- 1 MCU instead of 2
- Extends connectivity
- Enhance user interfaces
- Integrated SMPS (few ext. components needed)
STM32Trust on STM32H7 Series

Global security ecosystem and services

STM32 concept
Support customer’s
Secure Boot / Root Of Trust

SFI
A Secure Installer of
Secure Boot / Root Of Trust

SBSFU
A reference SW package for FW Update
and Secure Boot / Root Of Trust

www.st.com/stm32trust
Embedded Secure Firmware Install - SFI

Manage STM32 authentication, firmware decryption and installation

Customer premises

- SFI
  - FW
  - Encrypted FW
  - Store encryption key in HSM

Trusted Package Creator
- ST Hardware Secure Module (HSM)

3rd Party premises

- SMI
  - Module
  - Encrypted Module
  - Store encryption key in HSM

Trusted Package Creator
- ST Hardware Secure Module (HSM)

Untrusted environment

- Encrypted FW Transfer
- HSM
- Physical transfer
- SFI
- Authenticate target STM32
- Generate installation license
- STM32H7
- SMI
- Authenticate target STM32
- Generate installation license

Secure Loader
embedded services provisioned by ST ➔ Mass Market approach

ST ecosystem
with Encryption, HSM and programming tools

Firmware cloning protection on the first installation via UART / SPI / USB

Protect 3rd party Software IP (SMI)
Secure Boot Secure FW Update - SBSFU

Reference library source code for IAP

Demonstrate SW modules for:
- Secure Boot
- Secure Engine for Crypto and key
- Firmware Update image management

Ensure authentication and secure programming of in the field products

Reference implementation of STM32H7 hardware memory protections
A Full Set of Security

- AES-128/192/256 crypto engine
- DES/TDES crypto engine
- SHA-256 Authentication engine
- Certified Crypto library
- True Random Number Generator
- Unique ID
- Key provisioning for STM32 authentication

- Tamper and backup register
- Memory Protection Unit (MPU)
- Secure Boot
- Read and Write Protection
- Secure User Area (Hide Protect)
- PC-ROP
- JTAG fuse
- Octo-SPI On The Fly Decrypt engine on external NOR Flash

Some of the above features are optional and require to procure dedicated part numbers. Please refer to product specification.
Octo-SPI Encryption / Decryption with on the Fly Decrypt Engine

STM32H7

Main FW code in Flash

Write function

Plain text code or data

RSS reset And Encrypt

AES crypto engine

OTFDEC decrypt engine

OCTOSPI

External Flash

Enc code or data
Region 1

Encrypted Region 2

Encrypted Region 3

Encrypted Region 4

External Flash

Enc code or data

Plain text area

Define up to 4 regions encrypted with dedicated keys

AES-CTR 128 mode for Code and or Data management

Proprietary mode for advanced Code management

Execute In Place (XIP) encrypted code in external flash

Up to 140MHz bus speed
Detailed use-cases
Performance and smart architecture are yours to innovate
Create a Rich Human Machine Interface

Cortex-M7 - handling audio and rich HMI, Cortex-M4 running Real Time control tasks

Display
- High Resolution

Memory
- NOR Quad-SPI
- eMMC
- SDRAM
- SD card

Audio decoding and output

ARM Cortex-M7
- Display Interface
- Memory Interface
- RAM
- FLASH
- Main DMA
- Hi-res timer

ARM Cortex-M4
- Crypto Hash
- Chrom-Art Accelerator™
- JPEG codec accelerator
- RAM

STM32 H7
Seamlessly Move and Format Data

Main DMA - Flexible and high speed data transfers schemes without CPU load

Display

Memory

NOR Quad-SPI
eMMC
SDRAM
SD card

arm Cortex-M7

Chrom-ART Accelerator™
JPEG codec accelerator

Crypto Hash

ARM Cortex-M4

Display Interface

Memory Interface

RAM

RAM

FLASH

Main DMA

Hi-res timer
Reinforce the Security in your Solution

Cryptography and Hashing hardware assist
Authenticate your chip and securely install your code in memory
Control Real-time Applications

High resolution timer: advanced wave forms generation

Display

Memory
- NOR Quad-SPI
- eMMC
- SDRAM
- SD card

arm Cortex-M7

Chrom-ART Accelerator™ JPEG codec accelerator

Crypto Hash

Hi-res timer

Timing defined in multiple timers

RAM

Main DMA

FLASH
Industrial and Health & Wellness DNA

Industrial

- Error Code Correction on all Flash and RAM and dual core for safety
- Large choice of packages
- Advanced digital and analog
  (High resolution timer, 16-bit ADC, Op-Amp, Ethernet, CANFD…)
- High temperature -40°C up to 140°C junction temperature

Health & Wellness
Industrial and Health & Wellness DNA

Industrial

- **Inverters**
  Advanced timers and analog peripherals

- **Communication gateway**
  Rich connectivity and optional dual core

- **Human Machine Interface**
  Chrom-ART Accelerator™, Chrom-GRC™ and display interfaces for TFT and MIPI-DSI

Health & Wellness

- **Health and wellness**
  Chrom-ART Accelerator™, Chrom-GRC™ and display interfaces for TFT and MIPI-DSI

- **Individual assistance** (hearing, respiratory)
  Advanced timers and analog

- **Measurements and Data logger**
  Advanced Analog
Consumer DNA

Consumer

- Small packages
- Power efficiency and high performance
- Advanced audio and graphic
- High-speed peripherals
- Large expandable memories to support ever increasing communication protocols
• **IoT gateway**
  Large memory and rich communication peripherals

• **Access control**
  Chrom-ART Accelerator™, Chrom-GRC™ and display interfaces for TFT and MIPI-DSI

• **Drones**
  High processing architecture with dual core option, advanced timers and analog peripherals, small packages
STM32H7 ready ecosystem
Supported by the STM32 Ecosystem

Software

- Tools
- Embedded Software

Hardware

- STM32 Nucleo boards
- Discovery kits
- Evaluation boards

Customer support

- FAE - Worldwide Customer Support
- community.st.com
Software Tools for Dual-core Architecture

Complete support of Arm Dual Cortex-M architecture

**STM32CubeMX**
- **STM32CubeMX enhanced for Dual-core**
  - Configure and generate Code
  - Multi-core resources allocation
  - Peripherals configuration

**IDEs**
- **Compile and Debug**
  - Multi-Core Solutions
  - Partners IDE
  - Free IDE based on Eclipse
  - Multi-core debugging

**STM32 Programming Tool**
- **STM32CubeProg**
  - Program the application into the chip
  - Device information and readout
  - Signing tool & license generation
STM32H7 Hardware Solutions

Speed-up evaluation, prototyping and design

**Evaluation Boards**
- Full feature STM32H7 evaluation
  - STM32H743I-EVAL2
  - STM32H753I-EVAL2
  - STM32H747I-EVAL
  - STM32H757I-EVAL
  - STM32H7B3I-EVAL

**Discovery Kits**
- Flexible prototyping & demo
  - STM32H745I-DISCO
  - STM32H747I-DISCO
  - STM32H747I-DISC1
  - STM32H750B-DK
  - STM32H7B3I-DK

**Nucleo-144 Boards**
- Affordable and quick prototyping
  - NUCLEO-H743ZI2
  - NUCLEO-H753ZI
  - NUCLEO-H745ZI-Q / H755ZI-Q
  - NUCLEO-H7A3ZI-Q

Starting at $318
Starting at $97
Starting at $69
Starting at $87
Starting at $27
Software, Tools and Services
a Broad Ecosystem to Support Development

Large selection of partners already engaged for:
- Embedded software
- Software tools
- Graphics UI
- Security
- Training and services
### Tailored for Your Needs

- Single and Dual core versions
- High performance up to 480MHz
- 2MB Flash Dual Bank
- 1MB RAM
- More security features (Boot, Tamper …) and security services (optional)
- 35 communication peripherals
- 16-bit ADC up to 3.6Msps, up to 5MSPS in 12-bit, Comparators, Op Amp
- TT-CAN and FD-CAN
- High-Resolution timer (2.1ns)
- Low-Power Timers
- LDO and SMPS option
- Up to 140°C junction temperature
STM32H742 Single Core

- An entry level version of the STM32H7 series
- Easy migration from the F7 and F4 series due to the pin for pin compatibility on common packages
- A wide choice of packages and form factors
STM32H753/H743
Single Core General Purpose

- Easy migration from the F7 and F4 series due to the pin for pin compatibility on common packages
- A wide choice of packages and form factors
- Optional crypto variants offering the security services (SFI and SB-SFU) support
STM32H7A3/H7B3
Single Core General Purpose

- A STM32H7 single core with high memory integration
- LDO and SMPS for optimized power consumption
- A wide choice of packages and form factors
- Optional crypto variants offering the security services (SFI and SB-SFU) support
A STM32H7 running up to 480 MHz with Flash reduced to the essential to implement user bootloader and focus on external memories usage

- Come natively in Crypto variants only
- Add new package (LQFP144, LQFP176)
STM32H7B0 Value line

- A STM32H7 running up to 280 MHz with Flash reduced to the essential to implement user bootloader and focus on external memories usage
- Come natively in Crypto variants only
STM32H755/H745
Dual Core Industrial

- A STM32H7 Dual core version
- LDO and SMPS for optimized current consumption
- A wide choice of packages and form factors suitable for industrial or appliance applications
- Optional crypto variants offering security services (SFI & SB-SFU) support
- Optional support of extended Temperature range on specific part numbers
STM32H757/H747 Dual Core Graphic

- A STM32H7 Dual core version for advanced graphic thanks to the MIPI-DSI Phy allowing to connect high resolution displays
- LDO and SMPS for optimized current consumption
- A wide choice of packages and form factors suitable for highly integrated applications
- Optional crypto variants offering the security services (SFI and SB-SFU) support
Dual Core Block Diagram by Power Domain

Multi-power domain architecture for maximum flexibility and minimum power consumption

- **Three power domains for maximum flexibility**: To allow the shutdown of unused domains and minimize current consumption.
- **Power efficiency in RUN mode**: Thanks to 40nm process, dynamic voltage scaling and SMPS.
- **Batch Acquisition Mode Domain**: For always ON tasks, including Vbat subdomain with RTC and backup RAM.
Flexible Architecture for Power Efficiency

Only 60% of the dynamic power of the STM32H7 Single core thanks to the SMPS

Notes:
* from Flash (Cache ON and Reg. ON)
*** VOS5; Flash OFF, no IWDG
**** with RTC, at 3V

More details available in product Sheet available at www.st.com

Dynamic power divided by 3.5
Flexible Architecture for Power Efficiency

60% of the dynamic power thanks to the SMPS vs LDO

<table>
<thead>
<tr>
<th>Mode</th>
<th>Dynamic Power Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wake-up time to RUN</td>
<td></td>
</tr>
<tr>
<td>10 µs</td>
<td>120 µA / MHz</td>
</tr>
<tr>
<td>38 µs</td>
<td>41 µA / MHz</td>
</tr>
<tr>
<td>257 µs</td>
<td>32 µA / MHz</td>
</tr>
<tr>
<td>RUN at 280 MHz - PERIPH OFF</td>
<td>2.2 µA / 2.9 µA</td>
</tr>
<tr>
<td>Autonomous mode</td>
<td>41 µA / MHz</td>
</tr>
<tr>
<td>STOP Mode (DSTOP)</td>
<td>30 nA / 0.74 µA</td>
</tr>
<tr>
<td>STANDBY</td>
<td>258 µA</td>
</tr>
<tr>
<td>VBAT</td>
<td>2.2 µA / 2.9 µA</td>
</tr>
</tbody>
</table>

* from Flash (Cache ON and Peripheral OFF), SMPS ON
** BAM run at 64MHz, SPI clock 16 MHz, data stored in Smart Run Domain RAM via BDMA
*** VOS5, Flash LP mode, no IWDG, SMPS ON
**** with RTC

Typ with $V_{DD} = 3\,\text{V}$ @ 25°C
STM32H7 Microcontrollers Combine Dual-Core Performance with Rich Feature Integration

- System integration
- Advanced connectivity and control
- Security services

STM32H7x5 here
STM32H7x7 here
ST blog article here

www.st.com/STM32H7
New STM32H7 Microcontrollers for best combination of performance, integration and power saving inside an MCU ready for secure and SMART connected products

STM32H7 Single core
STM32H7A3/H7B3 & STM32H7B0 Value line

STM32H7A3
STM32H7B3
STM32H7B0

➤ STM32H7A3/H7B3 here
➤ STM32H7B0 Value line here

www.st.com/STM32H7
STM32H7 Series - Key Take Away

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