



# ST32F416-M

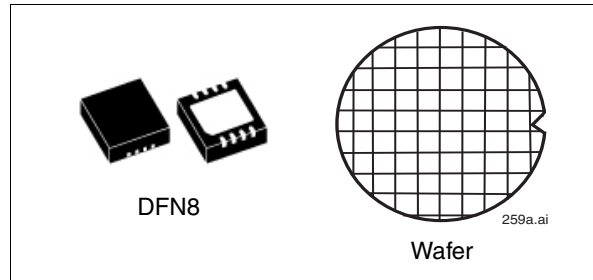
## M2M MCU with 32-bit ARM Cortex™ M3 CPU and 416 Kbyte high-density Flash memory

Data brief

### Features

#### Hardware features

- ARM Cortex™-M3 32-bit RISC core
- 12 Kbytes of user RAM
- 416 Kbytes of user Flash memory with OTP area:
  - 10-year data retention at 105°C, or 15 years at 85°C
  - 500,000 Erase/Write cycles per page
  - 50 million Erase/Write cycles per 64 Kbyte sector
  - Page granularity of 128 Bytes
  - Block granularity: 1 Kbyte
  - 128 Bytes of OTP for user
  - Page Erase time 4 ms
  - Block Erase 1 Kbyte in 20 ms
  - Programming performance up to 10µs/byte
  - Flash Erase / Write Protection software programmable on 64 Kbyte sectors
- Asynchronous Receiver Transmitter supporting ISO 7816-3 T=0 and T=1 protocols
- Two 16-bit timers with interrupt capability
- 1.8V, 3V and 5V supply voltage ranges
- External clock frequency from 1 up to 7.5 MHz
- High performance provided by:
  - CPU clock frequency up to 15 MHz
  - External clock multiplier (2x, 3x, and 4x)
- Current consumption compatible with GSM and ETSI specifications
- Power-saving Standby state
- Contact assignment compatible ISO 7816-2
- ESD protection greater than 4 kV (HBM)
- 8-pin DFN (6 x 5 mm) ECOPACK® package



#### Security features

- Monitoring of environmental parameters
- Protection against faults
- ISO 3309 CRC calculation block
- True random number generator
- Unique serial number on each die
- Hardware data encryption standard (DES) accelerator

#### Software features

- Flash loader
- Flash drivers

#### Development environment

- Software development and firmware generation are supported by a comprehensive set of development tools dedicated to software design and validation:
  - C compiler
  - Simulator
  - Emulator

### Description

The ST32F416-M is designed for machine-to-machine (M2M) applications. Its Cortex™-M3 32-bit RISC core operating at a 15-MHz frequency provides great performance and excellent code compacity.

# 1 Functional description

## 1.1 Hardware description

The ST32F416-M is a serial access microcontroller designed for machine-to-machine (M2M) applications that incorporates the most recent generation of ARM processors for embedded systems. Its Cortex™-M3 32-bit RISC core operating at a 15-MHz frequency brings great performance and excellent code compacity to the application thanks to the Thumb®-2 instruction set.

The high-speed embedded Flash 416 Kbyte memory introduces more flexibility to the system.

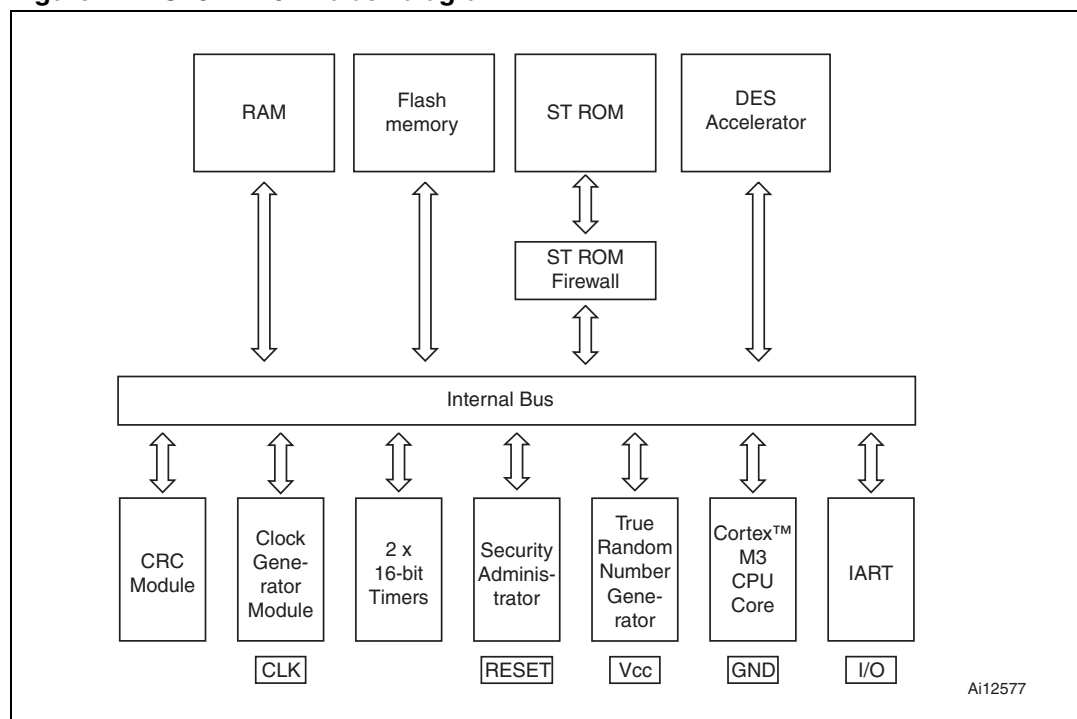
The ST32F416-M also offers a serial communication interface fully compatible with the ISO 7816-3 standard (T=0, T=1) for smartcard applications.

Two general purpose 16-bit timers are available.

A hardware Data Encryption Standard (DES) accelerator can be used to the user to optimize the application performance. A software library is provided for Advanced Encryption Standard (AES) implementation.

The ST32F416-M operates in the  $-40$  to  $+105^{\circ}\text{C}$  temperature range and 1.8 V, 3 V and 5 V supply voltage ranges. A comprehensive range of power-saving modes enables the design of efficient low-power applications.

**Figure 1. ST32F416-M block diagram**



## 1.2 Package features

Package qualification for M2M applications:

- Moisture Sensitivity Level test according to IPC/JEDEC J-STD-20: MSL1 with 260 °C peak temperature.
- Temperature Humidity Bias test according to JEDEC JESD22-A101: 85 °C, 85% RH, 1000 hours.
- Autoclave test according to JEDEC JESD22-A102: 121°C, 100% RH, 205 kPa, 96 hours.
- Vibration test according to JEDEC JESD22-B103 service condition 1: 20 / 2000 Hz, 20 g peak acceleration.
- Mechanical Shock test according to JEDEC JESD22-B104 service condition B: 1500 g acceleration for 0.5 ms pulse duration.
- Temperature cycling test according to JEDEC JESD22-A104: –65 / +150 °C, 500 cycles.

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

## 1.3 Software development tools description

Dedicated Cortex™-M3 software development tools are provided by ARM and Keil. This includes the Instruction Set Simulator (ISS) and C compiler. The documentation is available on the ARM and Keil web sites.

Moreover, STMicroelectronics provides:

- A time-accurate hardware emulator controlled by the Keil debugger and the ST development environment.
- A complete product simulator based on Keil's ISS simulator for the Cortex™-M3 CPU.
- A ROMed Flash Loader with very high-speed software downloading capabilities.

## 2 Revision history

**Table 1. Document revision history**

Date	Revision	Changes
02-Nov-2009	1	Initial release.
23-Feb-2010	2	Updated Page Erase and Block Erase times.
07-Jul-2010	3	Updated Features on page 1.

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