


## Multiprotocol wireless 32-bit MCU Arm<sup>®</sup>-based Cortex<sup>®</sup>-M4 with FPU, Bluetooth<sup>®</sup> Low Energy and 802.15.4 radio solution

Data brief - preliminary data

### Features

- Includes ST state-of-the-art patented technology
  - Radio
    - 2.4 GHz RF transceiver supporting Bluetooth<sup>®</sup> specification v5.0 and IEEE 802.15.4-2011 PHY and MAC
    - RX Sensitivity: -96 dBm (Bluetooth<sup>®</sup> Low Energy at 1 Mbps), -100 dBm (802.15.4)
    - Programmable output power up to +6 dBm with 1 dB steps
    - Integrated balun to reduce BOM
    - Support for 2 Mbps
    - Dedicated Arm<sup>®</sup> 32-bit Cortex<sup>®</sup>-M0+ CPU for real-time Radio layer
    - Accurate RSSI to enable power control
    - Compliant with radio frequency regulations ETSI EN 300 328, EN 300 440, FCC CFR47 Part 15 and ARIB STD-T66
  - Ultra-low-power platform
    - 1.71 V to 3.6 V power supply
    - 40 °C to 85 / 105 °C temperature ranges
    - 30 nA shutdown mode
    - 600 nA Standby mode + RTC + 32 KB RAM
    - 1.8 µA Stop mode + RTC + 256 KB RAM
    - Active-mode MCU + RF (SMPS ON): < 50 µA/MHz
    - RX: 3.8 mA
    - TX at 0 dBm: 5.5 mA
  - Core: Arm<sup>®</sup> 32-bit Cortex<sup>®</sup>-M4 CPU with FPU, Adaptive real-time accelerator (ART Accelerator<sup>™</sup>) allowing 0-wait-state execution from Flash memory, frequency up to 64 MHz, MPU, 80 DMIPS and DSP instructions
  - Supply and Reset management
    - High efficiency embedded SMPS step-down converter
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|             |             |              |
|-------------|-------------|--------------|
| UFQFPN48    | VFQFPN68    | WLCSP100     |
| 7 mm x 7 mm | 8 mm x 8 mm | 0.4 mm pitch |
| solder pad  | solder pad  |              |
- Ultra-safe, low-power BOR (brownout reset) with five selectable thresholds
    - Ultra-low-power POR/PDR
    - Programmable voltage detector (PVD)
    - V<sub>BAT</sub> mode with RTC and backup registers
  - Clock sources
    - 32 MHz crystal oscillator with integrated trimming capacitors (Radio and CPU clock)
    - 32 kHz crystal oscillator for RTC (LSE)
    - Internal low-power 32 kHz (±5%) RC (LSI1)
    - Internal low-power 32 kHz (stability ±500 ppm) RC (LSI2)
    - Internal multispeed 100 kHz to 48 MHz oscillator, auto-trimmed by LSE (better than ±0.25 % accuracy)
    - High Speed internal 16 MHz factory trimmed RC (±1%)
    - 2x PLL for system clock, USB, SAI and ADC
  - Memories
    - Up to 1 MB Flash memory with sector protection (PCROP) against R/W operations, enabling authentic Bluetooth<sup>®</sup> Low Energy and 802.15.4 SW stack
    - Up to 256 KB RAM, including 64 KB with hardware parity check
    - 20x32-bit Backup Register
    - Boot loader supporting, USART, SPI, I2C and USB interfaces
    - OTA (Over the Air) Bluetooth<sup>®</sup> Low Energy and 802.15.4 update
    - Quad SPI memory interface with XIP

- Rich Analog peripherals (down to 1.62 V)
  - 12-bit ADC 4.26MSPS, up to 16-bit with hardware oversampling, 200  $\mu$ A/MSPS
  - 2x ultra-low-power comparator
  - Accurate 2.5 V or 2.048 V reference voltage buffered output
- System peripherals
  - Inter Processor Communication Controller (IPCC) for communication with Bluetooth® Low Energy and 802.15.4
  - HW semaphores for resources sharing between CPUs
  - 2x DMA controllers (7x channels each) supporting ADC, SPI, I2C, USART, QSPI, SAI, AES, Timers
  - 1x USART (ISO 7816, IrDA, SPI Master, Modbus and Smartcard mode)
  - 1x LPUART (Low Power)
  - 2x SPI 32 Mbit/s
  - 2x I2C (SMBus/PMBus)
  - 1x SAI (dual channels)
  - 1x USB 2.0 FS device, crystal-less, BCD and LPM
  - Touch Sensing controller, up to 28 channels
  - LCD 8x40 with step-up converter
  - 1x 16-bit, four channels advanced timer
  - 2x 16-bits, two channels timer
  - 1x 32-bits, four channels timer
  - 2x 16-bits ultra-low-power timer
  - 1x independent SysTick
  - 1x independent watchdog
  - 1x window watchdog
- Security & ID
  - Secure Firmware Installation (SFI) for Bluetooth® Low Energy and 802.15.4 SW stack
  - 3x Hardware Encryption AES maximum 256-bit for the application, the Bluetooth® Low Energy and IEEE802.14.5
  - Customer key storage / key manager services
  - HW Public Key Authority (PKA)
  - Cryptographic algorithms: RSA, Diffie-Hellman, ECC over GF(p)
  - True random number generator (RNG)
  - Sector protection against R/W operation (PCROP)
  - CRC calculation unit
  - 96-bit unique ID
  - 64-bit unique ID. Possibility to derive 802.15.5 64-bit and Bluetooth® Low Energy 48-bit EUI
- Up to 72 fast I/Os, 70 of them 5 V-tolerant
- Development support
  - Serial wire debug (SWD), JTAG for the Application processor
  - Application cross trigger with input and output
  - Embedded Trace Macrocell™ for application
- All packages are ECOPACK2® compliant

Table 1. Device summary

| Reference   | Part numbers  |
|-------------|---|
| STM32WB55xx | STM32WB55CC, STM32WB55RC, STM32WB55VC<br>STM32WB55CE, STM32WB55RE, STM32WB55VE<br>STM32WB55CG, STM32WB55RG, STM32WB55VG |

# 1 Introduction

This data brief provides information on the STM32WB55xx microcontrollers.

For information on the Arm<sup>®(a)</sup> Cortex<sup>®</sup>-M4 and Cortex<sup>®</sup>-M0+ cores, refer, respectively, to the Cortex<sup>®</sup>-M4 Technical Reference Manual and to the Cortex<sup>®</sup>-M0+ Technical Reference Manual, both available from the [www.arm.com](http://www.arm.com) website.

For information on 802.15.4 refer to the IEEE website ([www.ieee.org](http://www.ieee.org)).

For information on Bluetooth<sup>®</sup> refer to [www.bluetooth.com](http://www.bluetooth.com).



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## 2 Description

The STM32WB55xx multiprotocol wireless and ultra-low-power devices embed a powerful and ultra-low-power radio compliant with the Bluetooth® Low Energy SIG specification v5.0 and with IEEE 802.15.4-2011. They contain a dedicated Arm® Cortex® -M0+ for performing all the real-time low layer operation.

The STM32WB55xx devices are designed to be extremely low-power and are based on the high-performance Arm® Cortex®-M4 32-bit RISC core operating at a frequency of up to 64 MHz. The Cortex®-M4 core features a Floating point unit (FPU) single precision that supports all Arm® single-precision data-processing instructions and data types. It also implements a full set of DSP instructions and a memory protection unit (MPU) that enhances application security.

Enhanced inter-processor communication is provided by the IPCC with six bidirectional channels. The HSEM provides hardware semaphores used to share common resources between the two processors.

The STM32WB55xx devices embed high-speed memories (Flash memory up to 1 Mbyte, up to 256 Kbyte of SRAM), a Quad-SPI Flash memory interface (available on all packages) and an extensive range of enhanced I/Os and peripherals.

Direct data transfer between memory and peripherals and from memory to memory is supported by 14 DMA channels with a full flexible channel mapping by the DMAMUX peripheral.

The STM32WB55xx devices embed several mechanisms for embedded Flash memory and SRAM: readout protection, write protection and proprietary code readout protection. Portions of the memory can be secured for Cortex® -M0+ exclusive access.

The two AES encryption engines, PKA and RNG enable lower layer MAC and upper layer cryptography. A customer key storage feature may be used to keep the keys hidden.

The devices offer one fast 16-bit ADC and two ultra-low-power comparators associated with a high accuracy reference voltage generator.

The STM32WB55xx devices embed a low-power RTC, one advanced 16-bit timer, one general-purpose 32-bit timer, two general-purpose 16-bit timers, and two 16-bit low-power timers.

In addition, up to 28 capacitive sensing channels are available. The devices also embed an integrated LCD driver up to 8x40 or 4x44, with internal step-up converter.

They also feature standard and advanced communication interfaces:

- one USART (ISO 7816, IrDA, Modbus and Smartcard mode)
- one Low Power UART (LPUART)
- two I2C (SMBus/PMBus)
- two SPI (up to 32 MHz)
- one Serial Audio Interface with two channels and three PDMs (SAI)
- one USB 2.0 FS device with embedded crystal-less oscillator, supporting BCD and LPM
- one Quad-SPI with Execute in Place (XIP) capability

The STM32WB55xx operate in the -40 to +105 °C (+125 °C junction) temperature range from a 1.71 to 3.6 V power supply. A comprehensive set of power-saving modes enables the design of low-power applications.

The STM32WB55xx integrate a high efficiency SMPS step-down converter. It includes independent power supplies for analog input for ADC and comparators, as well as a 3.3 V dedicated supply input for USB.

A  $V_{BAT}$  dedicated supply allows the devices to back up the LSE 32.768KHz oscillator, the RTC and the backup registers, thus enabling the STM32WB55xx to supply these functions even if the main  $V_{DD}$  is not present through a CR2032-like battery, a Supercap or a small rechargeable battery.

The STM32WB55xx family offers three packages, from 48 to 100 pins.

**Table 2. STM32WB55xx family device features and peripheral counts**

| Feature                          |                      | STM32WB55Cx                       |        |        | STM32WB55Rx                       |        |        | STM32WB55Vx       |        |        |
|----------------------------------|----------------------|-----------------------------------|--------|--------|-----------------------------------|--------|--------|-------------------|--------|--------|
| Flash memory density             |                      | 256 KB                            | 512 KB | 1 MB   | 256 KB                            | 512 KB | 1 MB   | 256 KB            | 512 KB | 1 MB   |
| SRAM density                     |                      | 128 KB                            | 256 KB | 256 KB | 128 KB                            | 256 KB | 256 KB | 128 KB            | 256 KB | 256 KB |
| BLE                              |                      | V5.0 (2 Mbps)                     |        |        |                                   |        |        |                   |        |        |
| 802.15.4                         |                      | Yes                               |        |        |                                   |        |        |                   |        |        |
| Timers                           | Advanced             | 1 (16 bits)                       |        |        |                                   |        |        |                   |        |        |
|                                  | General purpose      | 2 (16 bits) + 1 (32 bits)         |        |        |                                   |        |        |                   |        |        |
|                                  | Low power            | 2 (16 bits)                       |        |        |                                   |        |        |                   |        |        |
|                                  | SysTick              | 1                                 |        |        |                                   |        |        |                   |        |        |
| Comm interface                   | SPI                  | 1                                 |        |        | 2                                 |        |        |                   |        |        |
|                                  | I2C                  | 2                                 |        |        |                                   |        |        |                   |        |        |
|                                  | USART <sup>(1)</sup> | 1                                 |        |        |                                   |        |        |                   |        |        |
|                                  | LPUART               | 1                                 |        |        |                                   |        |        |                   |        |        |
|                                  | SAI                  | 2 channels                        |        |        |                                   |        |        |                   |        |        |
|                                  | USB FS               | Yes                               |        |        |                                   |        |        |                   |        |        |
|                                  | QSPI                 | 1                                 |        |        |                                   |        |        |                   |        |        |
| RTC                              |                      | 1                                 |        |        |                                   |        |        |                   |        |        |
| Tamper pin                       |                      | 1                                 |        |        | 3                                 |        |        |                   |        |        |
| Wakeup pin                       |                      | 2                                 |        |        | 5                                 |        |        |                   |        |        |
| LCD, COMxSEG                     |                      | Yes, 4x13                         |        |        | Yes, 7x23 or 4x26                 |        |        | Yes, 8x40 or 4x44 |        |        |
| GPIOs                            |                      | 30                                |        |        | 49                                |        |        | 72                |        |        |
| Capacitive sensing               |                      | 1x4                               |        |        | 3x4                               |        |        | 7x4               |        |        |
| 16-bit ADC<br>Number of channels |                      | 13 channels<br>(incl. 3 internal) |        |        | 19 channels<br>(incl. 3 internal) |        |        |                   |        |        |
| Internal V <sub>ref</sub>        |                      | No                                |        |        | Yes                               |        |        |                   |        |        |
| Analog comparator                |                      | 2                                 |        |        |                                   |        |        |                   |        |        |
| Max CPU frequency                |                      | 64 MHz                            |        |        |                                   |        |        |                   |        |        |

Table 2. STM32WB55xx family device features and peripheral counts (continued)

| Feature               | STM32WB55Cx  | STM32WB55Rx   | STM32WB55Vx              |
|-----------------------|--|---|--------------------------|
| Operating temperature | Ambient operating temperature: -40 to +105 °C<br>Junction temperature: -40 to 125 °C |   |                          |
| Operating voltage     | 1.71 to 3.6 V  |   |                          |
| Package               | UFQFPN48<br>7 mm x 7 mm<br>0.5 mm pitch, solder pad                                  | VFQFPN68<br>8 mm x 8 mm<br>0.4 mm pitch, solder pad | WLCSP100<br>0.4 mm pitch |

1. USART peripheral can be used as SPI master.

### 3 Revision history

**Table 3. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 22-Nov-2016 | 1        | Initial release.   |
| 31-Jan-2018 | 2        | Changed document classification, from ST Restricted to Public.<br>Updated <a href="#">Features</a> and <a href="#">Description</a> .<br>Removed former Sections <a href="#">3</a> to <a href="#">5</a> . |
| 15-May-2018 | 3        | Updated <a href="#">Features</a> and <a href="#">Description</a> .   |

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