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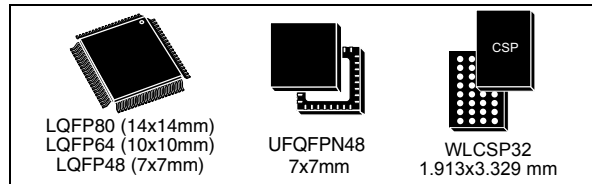


8-bit ultra-low-power MCU, up to 64 KB Flash, 2 KB data EEPROM, RTC, LCD, timers, USARTs, I2C, SPIs, ADC, DAC, comparators

Datasheet - production data

Features

- Operating conditions
 - Operating power supply: 1.65 to 3.6 V (without BOR), 1.8 to 3.6 V (with BOR)
 - Temp. range: -40 to 85, 105 or 125 °C
- Low-power features
 - 5 low-power modes: Wait, Low-power run (5.9 µA), Low-power wait (3 µA), Active-halt with full RTC (1.4 µA), Halt (400 nA)
 - Consumption: 200 µA/MHz+330 µA
 - Fast wake up from Halt mode (4.7 µs)
 - Ultra low leakage per I/O: 50 nA
- Advanced STM8 core
 - Harvard architecture and 3-stage pipeline
 - Max freq: 16 MHz, 16 CISC MIPS peak
 - Up to 40 external interrupt sources
- Reset and supply management
 - Low-power, ultra safe BOR reset with five programmable thresholds
 - Ultra-low-power POR/PDR
 - Programmable voltage detector (PVD)
- Clock management
 - 32 kHz and 1-16 MHz crystal oscillators
 - Internal 16 MHz factory-trimmed RC and 38 kHz low consumption RC
 - Clock security system
- Low-power RTC
 - BCD calendar with alarm interrupt,
 - Digital calibration with +/- 0.5ppm accuracy
 - Advanced anti-tamper detection
- LCD: 8x40 or 4x44 w/ step-up converter
- DMA
 - 4 ch. for ADC, DACs, SPIs, I²C, USARTs, Timers, 1 ch. for memory-to-memory
- 2x12-bit DAC (dual mode) with output buffer
- 12-bit ADC up to 1 Msps/28 channels
 - Temp. sensor and internal ref. voltage



- Memories
 - Up to 64 KB of Flash memory with up to 2KB of data EEPROM with ECC and RWW
 - Flexible write/read protection modes
 - Up to 4 KB of RAM
- 2 ultra-low-power comparators
 - 1 with fixed threshold and 1 rail to rail
 - Wake up capability
- Timers
 - Three 16-bit timers with 2 channels (IC, OC, PWM), quadrature encoder
 - One 16-bit advanced control timer with 3 channels, supporting motor control
 - One 8-bit timer with 7-bit prescaler
 - One window, one independent watchdog
 - Beeper timer with 1, 2 or 4 kHz frequencies
- Communication interfaces
 - Two synchronous serial interface (SPI)
 - Fast I²C 400 kHz SMBus and PMBus
 - Three USARTs (ISO 7816 interface + IrDA)
- Up to 67 I/Os, all mappable on interrupt vectors
- Up to 16 capacitive sensing channels supporting touchkey, proximity, linear touch and rotary touch sensors
- Fast on-chip programming and non-intrusive debugging with SWIM, Bootloader using USART
- 96-bit unique ID

Table 1. Device summary

Reference	Part number
STM8L151x6/8	STM8L151R6, STM8L151C8, STM8L151M8, STM8L151R8
STM8L152x6/8	STM8L152R6, STM8L152C8, STM8L152K8, STM8L152M8, STM8L152R8

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1 Introduction

This document describes the features, pinout, mechanical data and ordering information for: devices.

- **High-density STM8L15xxx devices:** STM8L151x8 and STM8L152x8 microcontrollers with a Flash memory density of 64 Kbyte.
- **Medium+ density STM8L15xxx devices:** STM8L151R6 and STM8L152R6 microcontrollers with Flash memory density of 32 Kbyte.

For further details on the STMicroelectronics ultra-low-power family please refer to [Section 2.3: Ultra-low-power continuum on page 12](#).

For detailed information on device operation and registers, refer to the reference manual (RM0031).

For information on to the Flash program memory and data EEPROM, refer to the programming manual (PM0054).

For information on the debug module and SWIM (single wire interface module), refer to the STM8 SWIM communication protocol and debug module user manual (UM0470).

For information on the STM8 core, refer to the STM8 CPU programming manual (PM0044).

2 Description

The high-density and medium+ density STM8L15xx6/8 ultra-low-power devices feature an enhanced STM8 CPU core providing increased processing power (up to 16 MIPS at 16 MHz) while maintaining the advantages of a CISC architecture with improved code density, a 24-bit linear addressing space and an optimized architecture for low-power operations.

The family includes an integrated debug module with a hardware interface (SWIM) which allows non-intrusive in-application debugging and ultrafast Flash programming.

All high-density and medium+ density STM8L15xx6/8 microcontrollers feature embedded data EEPROM and low-power low-voltage single-supply program Flash memory.

The devices incorporate an extensive range of enhanced I/Os and peripherals, a 12-bit ADC, two DACs, two comparators, a real-time clock, four 16-bit timers, one 8-bit timer, as well as standard communication interfaces such as two SPIs, an I²C interface, and three USARTs. A 8x40 or 4x44-segment LCD is available on the STM8L152x8 devices. The modular design of the peripheral set allows the same peripherals to be found in different ST microcontroller families including 32-bit families. This makes any transition to a different family very easy, and simplified even more by the use of a common set of development tools.

2.1 STM8L ultra-low-power 8-bit family benefits

High-density and medium+ density STM8L15xx6/8 devices are part of the STM8L ultra-low-power family providing the following benefits:

- Integrated system
 - Up to 64 Kbyte of high-density embedded Flash program memory
 - Up to 2 Kbyte of data EEPROM
 - Up to 4 Kbyte of RAM
 - Internal high-speed and low-power low speed RC.
 - Embedded reset
- ultra-low-power consumption
 - 1 μ A in Active-halt mode
 - Clock gated system and optimized power management
 - Capability to execute from RAM for Low-power wait mode and Low-power run mode
- Advanced features
 - Up to 16 MIPS at 16 MHz CPU clock frequency
 - Direct memory access (DMA) for memory-to-memory or peripheral-to-memory access.
- Short development cycles
 - Application scalability across a common family product architecture with compatible pinout, memory map and modular peripherals.
 - Wide choice of development tools

STM8L ultra-low-power microcontrollers can operate either from 1.8 to 3.6 V (down to 1.65 V at power-down) or from 1.65 to 3.6 V. They are available in the -40 to +85 °C and -40 to +125 °C temperature ranges.

These features make the STM8L ultra-low-power microcontroller families suitable for a wide range of applications:

- Medical and handheld equipment
- Application control and user interface
- PC peripherals, gaming, GPS and sport equipment
- Alarm systems, wired and wireless sensors
- Metering

The devices are offered in five different packages from 32 to 80 pins. Different sets of peripherals are included depending on the device. Refer to [Section 3](#) for an overview of the complete range of peripherals proposed in this family.

All STM8L ultra-low-power products are based on the same architecture with the same memory mapping and a coherent pinout.

[Figure 1](#) shows the block diagram of the High-density and medium+ density STM8L15xx6/8 families.

2.2 Device overview

Table 2. High-density and medium+ density STM8L15xx6/8 low power device features and peripheral counts

Features		STM8L15xC8	STM8L15xK8	STM8L15xR8	STM8L15xM8	STM8L15xR6
Flash (Kbyte)		64	64	64	64	32
Data EEPROM (Kbyte)		2	2	2	2	1
RAM (Kbyte)		4	4	4	4	2
LCD		8x24 or 4x28 ⁽¹⁾	4x15 ⁽¹⁾	8x36 or 4x40 ⁽¹⁾	8x40 or 4x44 ⁽¹⁾	8x36 or 4x40 ⁽¹⁾
Timers	Basic	1 (8-bit)	1 (8-bit)	1 (8-bit)	1 (8-bit)	1 (8-bit)
	General purpose	3 (16-bit)	3 (16-bit)	3 (16-bit)	3 (16-bit)	3 (16-bit)
	Advanced control	1 (16-bit)	1 (16-bit)	1 (16-bit)	1 (16-bit)	1 (16-bit)
Communication interfaces	SPI	2	1	2	2	2
	I2C	1	1	1	1	1
	USART	3	2	3	3	3
GPIOs		41 ⁽²⁾	28 ⁽²⁾	54 ⁽²⁾	68 ⁽²⁾	54 ⁽²⁾
12-bit synchronized ADC (number of channels)		1 (25)	1 (18)	1 (28)	1 (28)	1 (28)
12-Bit DAC		2	1	2	2	2
Number of channels		2	1	2	2	2
Comparators (COMP1/COMP2)		2	2	2	2	2
Others		RTC, window watchdog, independent watchdog, 16-MHz and 38-kHz internal RC, 1- to 16-MHz and 32-kHz external oscillator				
CPU frequency		16 MHz				
Operating voltage		1.8 to 3.6 V (down to 1.65 V at power-down) with BOR 1.65 to 3.6 V without BOR				
Operating temperature		-40 to +85 °C / -40 to +105 °C / -40 to +125 °C				
Packages		UFQFPN48 LQFP48	WLCSP32	LQFP64	LQFP80	LQFP64

1. STM8L152x6/8 versions only.

2. The number of GPIOs given in this table includes the NRST/PA1 pin but the application can use the NRST/PA1 pin as general purpose output only (PA1).

2.3 Ultra-low-power continuum

The ultra-low-power STM8L151x6/8, STM8L152x6/8 and STM8L162x8 are fully pin-to-pin, software and feature compatible. Besides the full compatibility within the family, the devices are part of STMicroelectronics microcontrollers ultra-low-power strategy which also includes STM8L101 line, STM8L151/152 lines, and STM8L162 line. The STM8L and STM32L families allow a continuum of performance, peripherals, system architecture, and features.

They are all based on STMicroelectronics 0.13 μm ultra low-leakage process.

- Note:*
- 1 The STM8L151xx and STM8L152xx are pin-to-pin compatible with STM8L101xx devices.
 - 2 The STM32L family is pin-to-pin compatible with the general purpose STM32F family. Please refer to STM32Lxxxxx documentation for more information on these devices.

Performance

All families incorporate highly energy-efficient cores with both Harvard architecture and pipelined execution: advanced STM8 core for STM8L families and ARM[®] Cortex[®]-M3 core for STM32L family. In addition specific care for the design architecture has been taken to optimize the mA/DMIPS and mA/MHz ratios.

This allows the ultra-low-power performance to range from 5 up to 33.3 DMIPs.

Shared peripherals

STM8L15xx6/8 and STM32Lxxxxx share identical peripherals which ensure a very easy migration from one family to another:

- Analog peripherals: ADC1, DAC1/DAC2, and comparators COMP1/COMP2
- Digital peripherals: RTC and some communication interfaces

Common system strategy

To offer flexibility and optimize performance, the STM8L15xx6/8 and STM32Lxxxxx devices use a common architecture:

- Same power supply range from 1.65 to 3.6 V. For STM8L101xx and medium-density STM8L15xxx, the power supply must be above 1.8 V at power-on, and go below 1.65 V at power-down.
- Architecture optimized to reach ultra low consumption both in low-power modes and Run mode
- Fast startup strategy from low-power modes
- Flexible system clock
- Ultra safe reset: same reset strategy for both STM8L15xx6/8 and STM32Lxxxxx including power-on reset, power-down reset, brownout reset and programmable voltage detector.

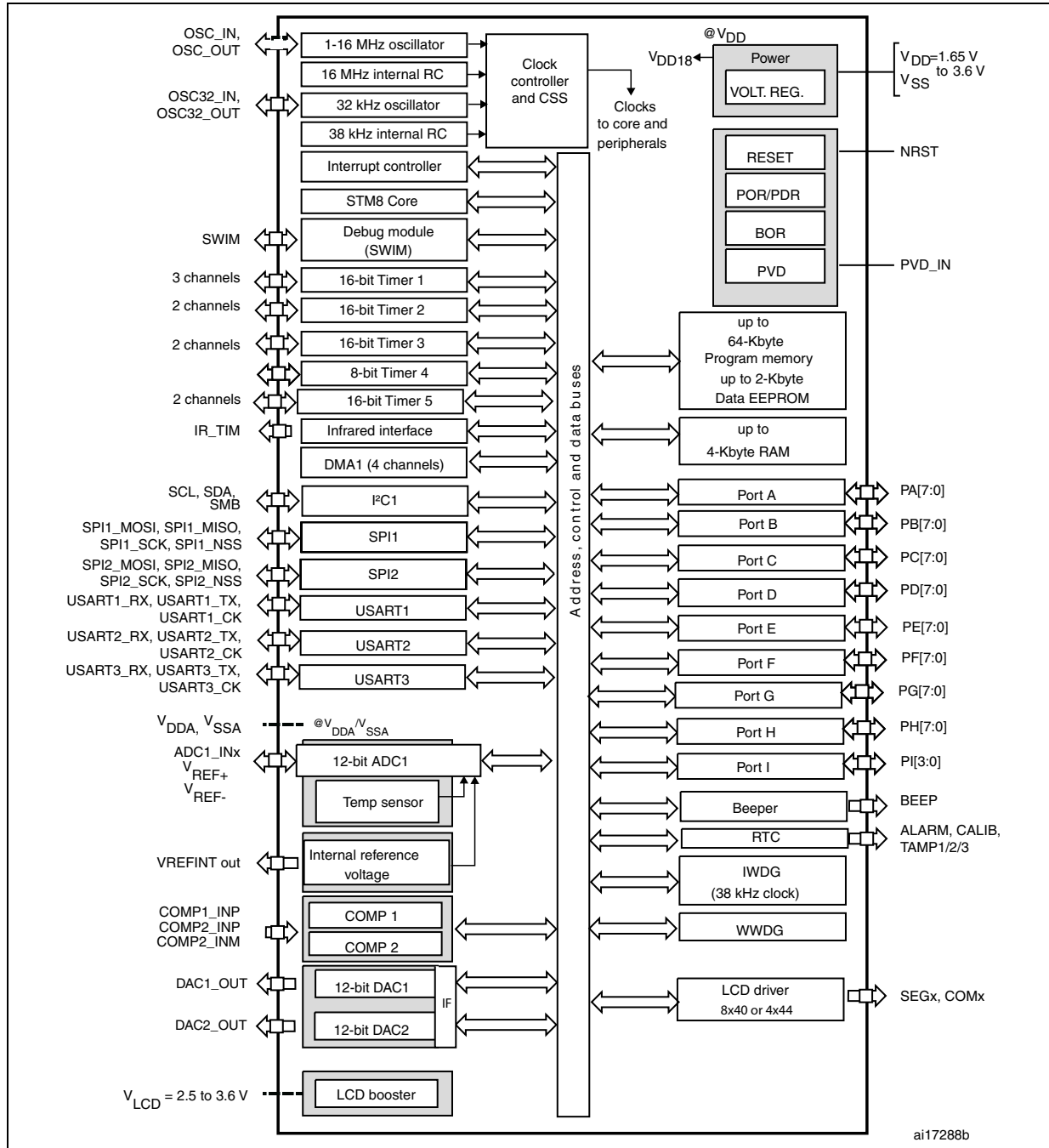
Features

STMicroelectronics ultra-low-power continuum also lies in feature compatibility:

- More than 10 packages with pin counts from 20 to 100 pins and size down to 3 x 3 mm
- Memory density ranging from 4 to 128 Kbyte

3 Functional overview

Figure 1. High-density and medium+ density STM8L15xx6/8 device block diagram



- Legend:**
 - AF: alternate function
 - ADC: Analog-to-digital converter
 - BOR: Brownout reset
 - DMA: Direct memory access
 - DAC: Digital-to-analog converter
 - I²C: Inter-integrated circuit multimaster interface
 - IWDG: Independent watchdog

LCD: Liquid crystal display
POR/PDR: Power on reset / power-down reset
RTC: Real-time clock
SPI: Serial peripheral interface
SWIM: Single wire interface module
USART: Universal synchronous asynchronous receiver transmitter
WWDG: Window watchdog

3.1 Low-power modes

The high-density and medium+ density STM8L15xx6/8 devices support five low-power modes to achieve the best compromise between low-power consumption, short startup time and available wakeup sources:

- **Wait mode:** CPU clock is stopped, but selected peripherals keep running. An internal or external interrupt or a Reset can be used to exit the microcontroller from Wait mode (WFE or WFI mode).
- **Low-power run mode:** The CPU and the selected peripherals are running. Execution is done from RAM with a low speed oscillator (LSI or LSE). Flash memory and data EEPROM are stopped and the voltage regulator is configured in ultra-low-power mode. The microcontroller enters Low-power run mode by software and can exit from this mode by software or by a reset.
All interrupts must be masked. They cannot be used to exit the microcontroller from this mode.
- **Low-power wait mode:** This mode is entered when executing a Wait for event in Low-power run mode. It is similar to Low-power run mode except that the CPU clock is stopped. The wakeup from this mode is triggered by a Reset or by an internal or external event (peripheral event generated by the timers, serial interfaces, DMA controller (DMA1), comparators and I/O ports). When the wakeup is triggered by an event, the system goes back to Low-power run mode.
All interrupts must be masked. They cannot be used to exit the microcontroller from this mode.
- **Active-halt mode:** CPU and peripheral clocks are stopped, except RTC. The wakeup can be triggered by RTC interrupts, external interrupts or reset.
- **Halt mode:** CPU and peripheral clocks are stopped, the device remains powered on. The RAM content is preserved. The wakeup is triggered by an external interrupt or reset. A few peripherals have also a wakeup from Halt capability. Switching off the internal reference voltage reduces power consumption. Through software configuration it is also possible to wake up the device without waiting for the internal reference voltage wakeup time to have a fast wakeup time of 5 μ s.

3.2 Central processing unit STM8

3.2.1 Advanced STM8 Core

The 8-bit STM8 core is designed for code efficiency and performance with an Harvard architecture and a 3-stage pipeline.

It contains 6 internal registers which are directly addressable in each execution context, 20 addressing modes including indexed indirect and relative addressing, and 80 instructions.

Architecture and registers

- Harvard architecture
- 3-stage pipeline
- 32-bit wide program memory bus - single cycle fetching most instructions
- X and Y 16-bit index registers - enabling indexed addressing modes with or without offset and read-modify-write type data manipulations
- 8-bit accumulator
- 24-bit program counter - 16 Mbyte linear memory space
- 16-bit stack pointer - access to a 64 Kbyte level stack
- 8-bit condition code register - 7 condition flags for the result of the last instruction

Addressing

- 20 addressing modes
- Indexed indirect addressing mode for lookup tables located anywhere in the address space
- Stack pointer relative addressing mode for local variables and parameter passing

Instruction set

- 80 instructions with 2-byte average instruction size
- Standard data movement and logic/arithmetic functions
- 8-bit by 8-bit multiplication
- 16-bit by 8-bit and 16-bit by 16-bit division
- Bit manipulation
- Data transfer between stack and accumulator (push/pop) with direct stack access
- Data transfer using the X and Y registers or direct memory-to-memory transfers

3.2.2 Interrupt controller

The high-density and medium+ density STM8L15xx6/8x devices feature a nested vectored interrupt controller:

- Nested interrupts with 3 software priority levels
- 32 interrupt vectors with hardware priority
- Up to 40 external interrupt sources on 11 vectors
- Trap and reset interrupts

3.3 Reset and supply management

3.3.1 Power supply scheme

The device requires a 1.65 V to 3.6 V operating supply voltage (V_{DD}). The external power supply pins must be connected as follows:

- V_{SS1} , V_{DD1} , V_{SS2} , V_{DD2} , V_{SS3} , V_{DD3} , V_{SS4} , V_{DD4} = 1.65 to 3.6 V: external power supply for I/Os and for the internal regulator. Provided externally through V_{DD} pins, the corresponding ground pin is V_{SS} . $V_{SS1}/V_{SS2}/V_{SS3}/V_{SS4}$ and $V_{DD1}/V_{DD2}/V_{DD3}/V_{DD4}$ must not be left unconnected.
- V_{SSA} , V_{DDA} = 1.65 to 3.6 V: external power supplies for analog peripherals (minimum voltage to be applied to V_{DDA} is 1.8 V when the ADC1 is used). V_{DDA} and V_{SSA} must be connected to V_{DD} and V_{SS} , respectively.
- V_{REF+} , V_{REF-} (for ADC1): external reference voltage for ADC1. Must be provided externally through V_{REF+} and V_{REF-} pin.
- V_{REF+} (for DAC1/2): external voltage reference for DAC1 and DAC2 must be provided externally through V_{REF+} .

3.3.2 Power supply supervisor

The device has an integrated ZEROPOWER power-on reset (POR)/power-down reset (PDR). For the device sales types without the “D” option (see [Section 11: Ordering information scheme](#)), it is coupled with a brownout reset (BOR) circuitry. In that case the device operates between 1.8 and 3.6 V, BOR is always active and ensures proper operation starting from 1.8 V. After the 1.8 V BOR threshold is reached, the option byte loading process starts, either to confirm or modify default thresholds, or to disable BOR permanently (in which case, the V_{DD} min. value at power-down is 1.65 V).

Five BOR thresholds are available through option bytes, starting from 1.8 V to 3 V. To reduce the power consumption in Halt mode, it is possible to automatically switch off the internal reference voltage (and consequently the BOR) in Halt mode. The device remains in reset state when V_{DD} is below a specified threshold, $V_{POR/PDR}$ or V_{BOR} , without the need for any external reset circuit.

Note: For device sales types with the “D” option (see [Section 11: Ordering information scheme](#)) BOR is permanently disabled and the device operates between 1.65 and 3.6 V. In this case it is not possible to enable BOR through the option bytes.

The device features an embedded programmable voltage detector (PVD) that monitors the V_{DD}/V_{DDA} power supply and compares it to the V_{PVD} threshold. This PVD offers 7 different levels between 1.85 V and 3.05 V, chosen by software, with a step around 200 mV. An interrupt can be generated when V_{DD}/V_{DDA} drops below the V_{PVD} threshold and/or when V_{DD}/V_{DDA} is higher than the V_{PVD} threshold. The interrupt service routine can then generate a warning message and/or put the MCU into a safe state. The PVD is enabled by software.

3.3.3 Voltage regulator

The high-density and medium+ density STM8L15xx6/8 devices embed an internal voltage regulator for generating the 1.8 V power supply for the core and peripherals.

This regulator has two different modes:

- Main voltage regulator mode (MVR) for Run, Wait for interrupt (WFI) and Wait for event (WFE) modes.
- Low-power voltage regulator mode (LPVR) for Halt, Active-halt, Low-power run and Low-power wait modes.

When entering Halt or Active-halt modes, the system automatically switches from the MVR to the LPVR in order to reduce current consumption.

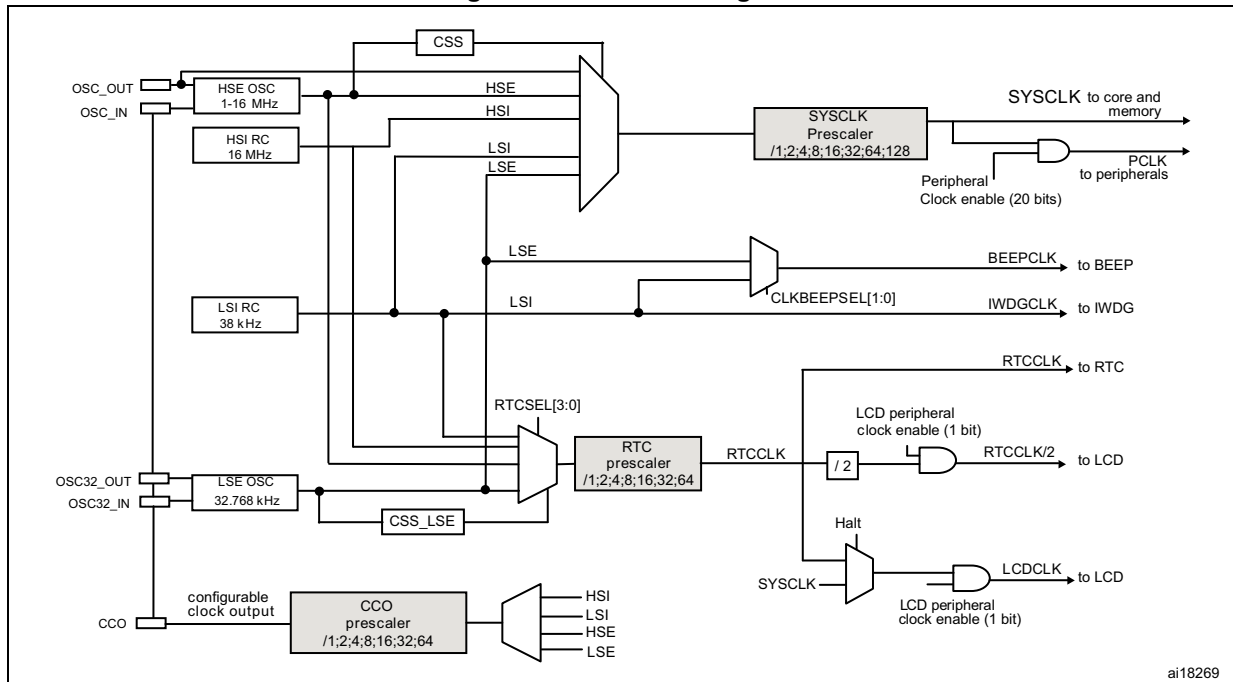
3.4 Clock management

The clock controller distributes the system clock (SYSCLK) coming from different oscillators to the core and the peripherals. It also manages clock gating for low-power modes and ensures clock robustness.

Features

- **Clock prescaler:** to get the best compromise between speed and current consumption the clock frequency to the CPU and peripherals can be adjusted by a programmable prescaler
- **Safe clock switching:** Clock sources can be changed safely on the fly in run mode through a configuration register.
- **Clock management:** To reduce power consumption, the clock controller can stop the clock to the core, individual peripherals or memory.
- **System clock sources:** 4 different clock sources can be used to drive the system clock:
 - 1-16 MHz High speed external crystal (HSE)
 - 16 MHz High speed internal RC oscillator (HSI)
 - 32.768 Low speed external crystal (LSE) available on STM8L151xx and STM8L152xx devices
 - 38 kHz Low speed internal RC (LSI)
- **RTC and LCD clock sources:** the above four sources can be chosen to clock the RTC and the LCD, whatever the system clock.
- **Startup clock:** After reset, the microcontroller restarts by default with an internal 2 MHz clock (HSI/8). The prescaler ratio and clock source can be changed by the application program as soon as the code execution starts.
- **Clock security system (CSS):** This feature can be enabled by software. If a HSE clock failure occurs, the system clock is automatically switched to HSI.
- **Configurable main clock output (CCO):** This outputs an external clock for use by the application.

Figure 2. Clock tree diagram



3.5 Low-power real-time clock

The real-time clock (RTC) is only available on STM8L151xx and STM8L152xx devices.

The real-time clock (RTC) is an independent binary coded decimal (BCD) timer/counter.

Six byte locations contain the second, minute, hour (12/24 hour), week day, date, month, year, in BCD (binary coded decimal) format. Correction for 28, 29 (leap year), 30, and 31 day months are made automatically. The subsecond field can also be read in binary format.

The calendar can be corrected from 1 to 32767 RTC clock pulses. This allows to make a synchronization to a master clock.

The RTC offers a digital calibration which allows an accuracy of +/-0.5 ppm.

It provides a programmable alarm and programmable periodic interrupts with wakeup from Halt capability.

- Periodic wakeup time using the 32.768 kHz LSE with the lowest resolution (of 61 μs) is from min. 122 μs to max. 3.9 s. With a different resolution, the wakeup time can reach 36 hours
- Periodic alarms based on the calendar can also be generated from LSE period to every year

A clock security system detects a failure on LSE, and can provide an interrupt with wakeup capability. The RTC clock can automatically switch to LSI in case of LSE failure.

The RTC also provides 3 anti-tamper detection pins. This detection embeds a programmable filter and can wakeup the MCU.

3.6 LCD (Liquid crystal display)

The LCD is only available on STM8L152x6/8 devices.

The liquid crystal display drives up to 8 common terminals and up to 40 segment terminals to drive up to 320 pixels. It can also be configured to drive up to 4 common and 44 segments (up to 176 pixels).

- Internal step-up converter to guarantee contrast control whatever V_{DD} .
- Static 1/2, 1/3, 1/4, 1/8 duty supported.
- Static 1/2, 1/3, 1/4 bias supported.
- Phase inversion to reduce power consumption and EMI.
- Up to 8 pixels which can programmed to blink.
- The LCD controller can operate in Halt mode.

Note: Unnecessary segments and common pins can be used as general I/O pins.

3.7 Memories

The high-density and medium+ density STM8L15xx6/8 devices have the following main features:

- Up to 4 Kbyte of RAM
- The non-volatile memory is divided into three arrays:
 - Up to 64 Kbyte of medium-density embedded Flash program memory
 - Up to 2 Kbyte of Data EEPROM
 - Option bytes.

The EEPROM embeds the error correction code (ECC) feature. It supports the read-while-write (RWW): it is possible to execute the code from the program matrix while programming/erasing the data matrix.

The option byte protects part of the Flash program memory from write and readout piracy.

3.8 DMA

A 4-channel direct memory access controller (DMA1) offers a memory-to-memory and peripherals-from/to-memory transfer capability. The 4 channels are shared between the following IPs with DMA capability: ADC1, DAC1, DAC2, I2C1, SPI1, SPI2, USART1, USART2, USART3, and the 5 Timers.

3.9 Analog-to-digital converter

- 12-bit analog-to-digital converter (ADC1) with 28 channels (including 4 fast channel), temperature sensor and internal reference voltage
- Conversion time down to 1 μ s with $f_{\text{SYSCLK}} = 16$ MHz
- Programmable resolution
- Programmable sampling time
- Single and continuous mode of conversion
- Scan capability: automatic conversion performed on a selected group of analog inputs
- Analog watchdog: interrupt generation when the converted voltage is outside the programmed threshold
- Triggered by timer

Note: ADC1 can be served by DMA1.

3.10 Digital-to-analog converter

- 12-bit DAC with 2 buffered outputs (two digital signals can be converted into two analog voltage signal outputs)
- Synchronized update capability using timers
- DMA capability for each channel
- External triggers for conversion
- Noise-wave generation
- Triangular-wave generation
- Dual DAC channels with independent or simultaneous conversions
- Input reference voltage $V_{\text{REF+}}$ for better resolution

Note: DAC can be served by DMA1.

3.11 Ultra-low-power comparators

The high-density and medium+ density STM8L15xx6/8 devices embed two comparators (COMP1 and COMP2) sharing the same current bias and voltage reference. The voltage reference can be internal or external (coming from an I/O).

- One comparator with fixed threshold (COMP1).
- One comparator rail to rail with fast or slow mode (COMP2). The threshold can be one of the following:
 - DAC output
 - External I/O
 - Internal reference voltage or internal reference voltage submultiple (1/4, 1/2, 3/4)

The two comparators can be used together to offer a window function. They can wake up from Halt mode.

3.12 System configuration controller and routing interface

The system configuration controller provides the capability to remap some alternate functions on different I/O ports. TIM4 and ADC1 DMA channels can also be remapped.

The highly flexible routing interface allows application software to control the routing of different I/Os to the TIM1 timer input captures. It also controls the routing of internal analog signals to ADC1, COMP1, COMP2, DAC1 and the internal reference voltage V_{REFINT} . It also provides a set of registers for efficiently managing the charge transfer acquisition sequence (see [Section 3.13: Touch sensing](#)).

3.13 Touch sensing

The high-density and medium+ density STM8L15xx6/8 devices provide a simple solution for adding capacitive sensing functionality to any application. Capacitive sensing technology is able to detect finger presence near an electrode which is protected from direct touch by a dielectric (for example glass or plastic). The capacitive variation introduced by the finger (or any conductive object) is measured using a proven implementation based on a surface charge transfer acquisition principle. It consists of charging the electrode capacitance and then transferring a part of the accumulated charges into a sampling capacitor until the voltage across this capacitor has reached a specific threshold. In the high-density and medium+ density STM8L15xx6/8 devices, the acquisition sequence is managed by software and it involves analog I/O groups and the routing interface.

Reliable touch sensing solution can be quickly and easily implemented using the free STM8 touch sensing firmware library.

3.14 Timers

The high-density and medium+ density STM8L15xx6/8 devices contain one advanced control timer (TIM1), three 16-bit general purpose timers (TIM2, TIM3 and TIM5) and one 8-bit basic timer (TIM4).

All the timers can be served by DMA1.

[Table 3](#) compares the features of the advanced control, general-purpose and basic timers.

Table 3. Timer feature comparison

Timer	Counter resolution	Counter type	Prescaler factor	DMA1 request generation	Capture/compare channels	Complementary outputs
TIM1	16-bit	up/down	Any integer from 1 to 65536	Yes	3 + 1	3
TIM2			Any power of 2 from 1 to 128		2	None
TIM3						
TIM5						
TIM4	8-bit	up	Any power of 2 from 1 to 32768		0	

3.14.1 16-bit advanced control timer (TIM1)

This is a high-end timer designed for a wide range of control applications. With its complementary outputs, dead-time control and center-aligned PWM capability, the field of applications is extended to motor control, lighting and half-bridge driver.

- 16-bit up, down and up/down autoreload counter with 16-bit prescaler
- 3 independent capture/compare channels (CAPCOM) configurable as input capture, output compare, PWM generation (edge and center aligned mode) and single pulse mode output
- 1 additional capture/compare channel which is not connected to an external I/O
- Synchronization module to control the timer with external signals
- Break input to force timer outputs into a defined state
- 3 complementary outputs with adjustable dead time
- Encoder mode
- Interrupt capability on various events (capture, compare, overflow, break, trigger)

3.14.2 16-bit general purpose timers (TIM2, TIM3, TIM5)

- 16-bit autoreload (AR) up/down-counter
- 7-bit prescaler adjustable to fixed power of 2 ratios (1...128)
- 2 individually configurable capture/compare channels
- PWM mode
- Interrupt capability on various events (capture, compare, overflow, break, trigger)
- Synchronization with other timers or external signals (external clock, reset, trigger and enable)

3.14.3 8-bit basic timer (TIM4)

The 8-bit timer consists of an 8-bit up auto-reload counter driven by a programmable prescaler. It can be used for timebase generation with interrupt generation on timer overflow or for DAC trigger generation.

3.15 Watchdog timers

The watchdog system is based on two independent timers providing maximum security to the applications.

3.15.1 Window watchdog timer

The window watchdog (WWDG) is used to detect the occurrence of a software fault, usually generated by external interferences or by unexpected logical conditions, which cause the application program to abandon its normal sequence.

3.15.2 Independent watchdog timer

The independent watchdog peripheral (IWDG) can be used to resolve processor malfunctions due to hardware or software failures.

It is clocked by the internal LSI RC clock source, and thus stays active even in case of a CPU clock failure.

3.16 Beeper

The beeper function outputs a signal on the BEEP pin for sound generation. The signal is in the range of 1, 2 or 4 kHz.

3.17 Communication interfaces

3.17.1 SPI

The serial peripheral interfaces (SPI1 and SPI2) provide half/ full duplex synchronous serial communication with external devices.

- Maximum speed: 8 Mbit/s ($f_{\text{SYSCLK}}/2$) both for master and slave
- Full duplex synchronous transfers
- Simplex synchronous transfers on 2 lines with a possible bidirectional data line
- Master or slave operation - selectable by hardware or software
- Hardware CRC calculation
- Slave/master selection input pin

Note: SPI1 and SPI2 can be served by the DMA1 Controller.

3.17.2 I²C

The I²C bus interface (I2C1) provides multi-master capability, and controls all I²C bus-specific sequencing, protocol, arbitration and timing.

- Master, slave and multi-master capability
- Standard mode up to 100 kHz and fast speed modes up to 400 kHz.
- 7-bit and 10-bit addressing modes.
- SMBus 2.0 and PMBus support
- Hardware CRC calculation

Note: I²C1 can be served by the DMA1 Controller.

3.17.3 USART

The USART interfaces (USART1, USART2 and USART3) allow full duplex, asynchronous communications with external devices requiring an industry standard NRZ asynchronous serial data format. It offers a very wide range of baud rates.

- 1 Mbit/s full duplex SCI
- SPI1 emulation
- High precision baud rate generator
- Smartcard emulation
- IrDA SIR encoder decoder
- Single wire half duplex mode

Note: USART1, USART2 and USART3 can be served by the DMA1 Controller.

3.18 Infrared (IR) interface

The high-density and medium+ density STM8L15xx6/8 devices contain an infrared interface which can be used with an IR LED for remote control functions. Two timer output compare channels are used to generate the infrared remote control signals.

3.19 Development support

Development tools

Development tools for the STM8 microcontrollers include:

- The STice emulation system offering tracing and code profiling
- The STVD high-level language debugger including C compiler, assembler and integrated development environment
- The STVP Flash programming software

The STM8 also comes with starter kits, evaluation boards and low-cost in-circuit debugging/programming tools.

Single wire data interface (SWIM) and debug module

The debug module with its single wire data interface (SWIM) permits non-intrusive real-time in-circuit debugging and fast memory programming.

The Single wire interface is used for direct access to the debugging module and memory programming. The interface can be activated in all device operation modes.

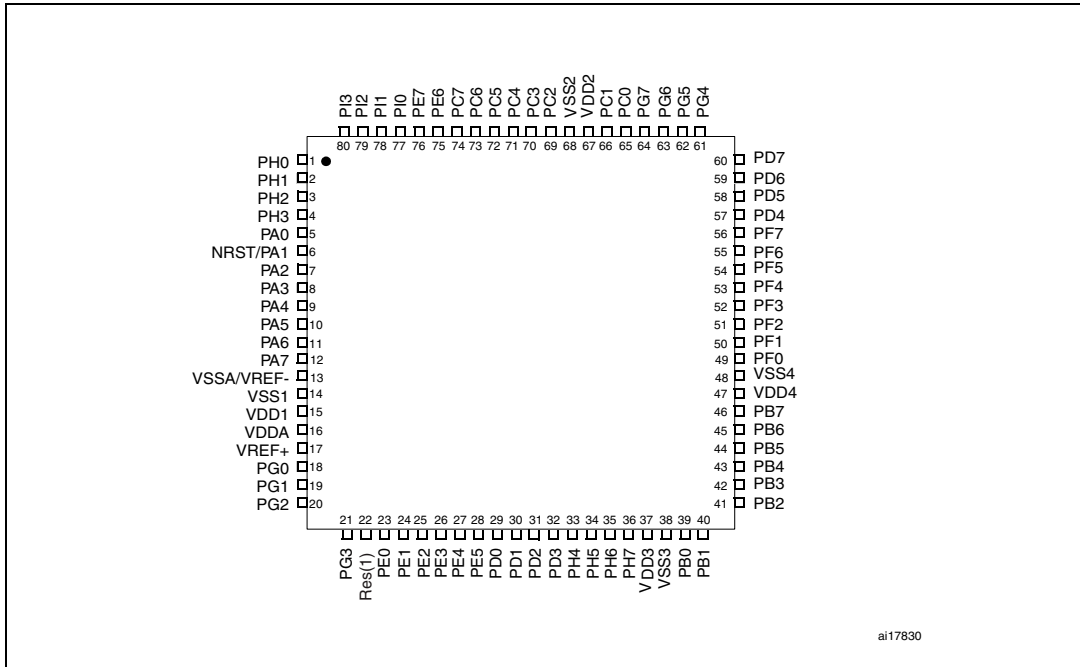
The non-intrusive debugging module features a performance close to a full-featured emulator. Beside memory and peripherals, CPU operation can also be monitored in real-time by means of shadow registers.

Bootloader

A bootloader is available to reprogram the Flash memory using the USART1, USART2, USART3 (USARTs in asynchronous mode), SPI1 or SPI2 interfaces. The reference document for the bootloader is *UM0560: STM8 bootloader user manual*.

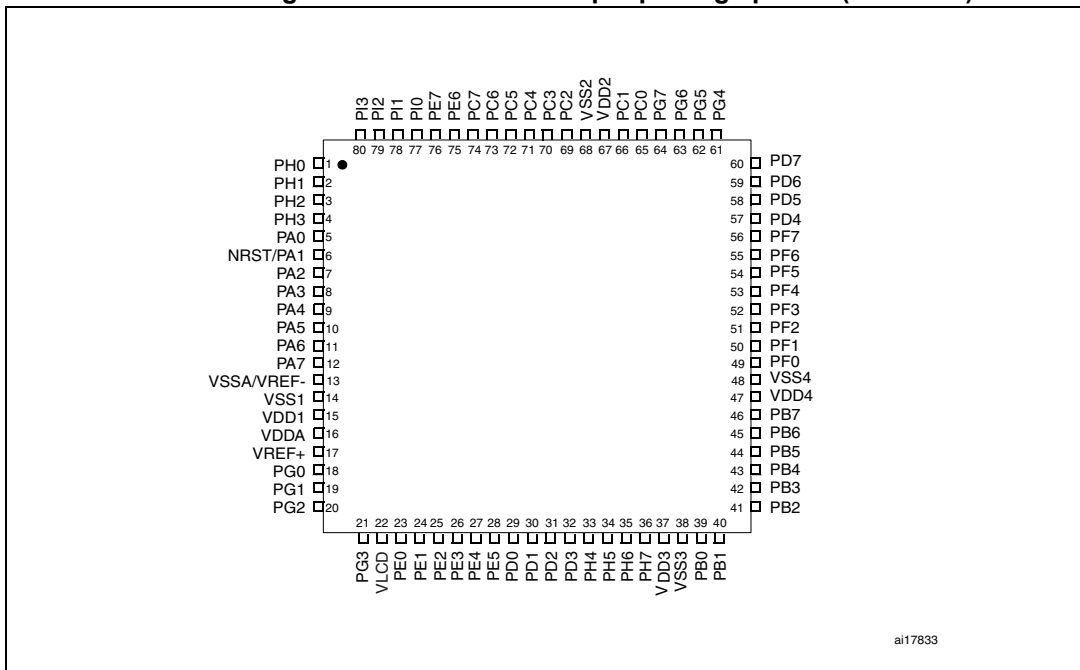
4 Pin description

Figure 3. STM8L151M8 80-pin package pinout (without LCD)



1. Pin 22 is reserved and must be tied to V_{DD} .
2. The above figure shows the package top view.

Figure 4. STM8L152M8 80-pin package pinout (with LCD)



1. The above figure shows the package top view.