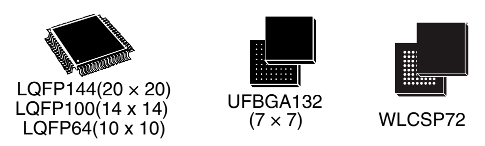
STM32L476xx

Ultra-low-power ARM® Cortex®-M4 32-bit MCU+FPU, 100DMIPS, up to 1MB Flash, 128 KB SRAM, USB OTG FS, LCD, analog, audio

Data brief

Features

- Ultra-low-power with FlexPowerControl
  - 1.71 V to 3.6 V power supply
  - -40 °C to 85/105/125 °C temperature range
  - 300 nA in V_{BAT} mode: supply for RTC and 32x32-bit backup registers
  - 30 nA Shutdown mode (5 wakeup pins)
  - 130 nA Standby mode (5 wakeup pins)
  - 430 nA Standby mode with RTC
  - 1.1 µA Stop 2 mode, 1.4 µA Stop 2 with RTC
  - 100 µA/MHz run mode
  - Batch acquisition mode (BAM)
  - 4 µs wakeup from Stop mode
  - Brown out reset (BOR) in all modes except shutdown
  - Interconnect matrix
- Core: ARM® 32-bit Cortex®-M4 CPU with FPU, Adaptive real-time accelerator (Chrom-ART Accelerator™) allowing 0-wait-state execution from Flash memory, frequency up to 80 MHz, MPU, 100DMIPS/1.25DMIPS/MHz (Dhrystone 2.1), and DSP instructions
- Clock Sources
  - 4 to 48 MHz crystal oscillator
  - 32 kHz crystal oscillator for RTC (LSE)
  - Internal 16 MHz factory-trimmed RC (±1%)
  - Internal low-power 32 kHz RC (±5%)
  - Internal multispeed 100 kHz to 48 MHz oscillator, auto-trimmed by LSE (better than ±0.25 % accuracy)
  - 3 PLLs for system clock, USB, audio, ADC
- RTC with HW calendar, alarms and calibration
- LCD 8 × 40 or 4 × 44 with step-up converter
- Up to 24 capacitive sensing channels: support touchkey, linear and rotary touch sensors
- 16x timers: 2x 16-bit advanced motor-control, 2x 32-bit and 5x 16-bit general purpose, 2x 16-bit basic, 2x low-power 16-bit timers (available in Stop mode), 2x watchdogs, SysTick timer
- Up to 114 fast I/Os, most 5 V-tolerant, up to 14 I/Os with independent supply down to 1.08 V



- Memories
  - Up to 1 MB Flash, 2 banks read-while-write, proprietary code readout protection
  - Up to 128 KB of SRAM including 32 KB with hardware parity check
  - External memory interface for static memories supporting SRAM, PSRAM, NOR and NAND memories
  - Quad SPI memory interface
- 4x digital filters for sigma delta modulator
- Rich analog peripherals (independent supply)
  - 3× 12-bit ADC 5 MSPS, up to 16-bit with hardware oversampling, 200 µA/MSPS
  - 2x 12-bit DAC, low-power sample and hold
  - 2x operational amplifiers with built-in PGA
  - 2x ultra-low-power comparators
- 18x communication interfaces
  - USB OTG 2.0 full-speed, LPM and BCD
  - 2x SAIs (serial audio interface)
  - 3x I2C FM+(1 Mbit/s), SMBus/PMBus
  - 6x USARTs (ISO 7816, LIN, IrDA, modem)
  - 3x SPIs (4x SPIs with the Quad SPI)
  - CAN (2.0B Active) and SDMMC interface
  - SWPMI single wire protocol master I/F
- 14-channel DMA controller
- True random number generator
- CRC calculation unit, 96-bit unique ID
- Development support: serial wire debug (SWD), JTAG, Embedded Trace Macrocell™

Table 1. Device summary

Reference	Part number
STM32L476xx	STM32L476RG, STM32L476JG, STM32L476VG, STM32L476QG, STM32L476ZG, STM32L476RE, STM32L476JE, STM32L476VE, STM32L476QE, STM32L476ZE, STM32L476RC, STM32L476VC

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1 Introduction

This data brief provides the ordering information and mechanical device characteristics of the STM32L476xx microcontrollers.

This document should be read in conjunction with the STM32L4x6 reference manual (RM0351).

For information on the ARM® Cortex®-M4 core, please refer to the Cortex®-M4 Technical Reference Manual, available from the www.arm.com website.

2 Description

The STM32L476xx devices are the ultra-low-power microcontrollers based on the high-performance ARM® Cortex®-M4 32-bit RISC core operating at a frequency of up to 80 MHz. The Cortex-M4 core features a Floating point unit (FPU) single precision which 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) which enhances application security.

The STM32L476xx devices embed high-speed memories (Flash memory up to 1 Mbyte, up to 128 Kbyte of SRAM), a flexible external memory controller (FSMC) for static memories (for devices with packages of 100 pins and more), a quad SPI flash memories interface (available on all packages) and an extensive range of enhanced I/Os and peripherals connected to two APB buses, two AHB buses and a 32-bit multi-AHB bus matrix.

The STM32L476xx devices embed several protection mechanisms for embedded Flash memory and SRAM: readout protection, write protection, proprietary code readout protection and Firewall.

The devices offer up to three fast 12-bit ADCs (5 MSPS), two comparators, two operational amplifiers, two DAC channels, an internal voltage reference buffer, a low-power RTC, two general-purpose 32-bit timer, two 16-bit PWM timers dedicated to motor control, seven general-purpose 16-bit timers, and two 16-bit low-power timers. The devices support four digital filters for external sigma delta modulators (DFSDM).

In addition, up to 24 capacitive sensing channels are available. The devices also embed an integrated LCD driver 8x40 or 4x44, with internal step-up converter.

They also feature standard and advanced communication interfaces.

- Three I2Cs
- Three SPIs
- Three USARTs, two UARTs and one Low-Power UART.
- Two SAIs (Serial Audio Interfaces)
- One SDMMC
- One CAN
- One USB OTG full-speed
- One SWPMI (Single Wire Protocol Master Interface)

The STM32L476xx operates in the -40 to +85 °C (+105 °C junction), -40 to +105 °C (+125 °C junction) and -40 to +125 °C (+130 °C junction) temperature ranges from a 1.71 to 3.6 V power supply. A comprehensive set of power-saving modes allows the design of low-power applications.

Some independent power supplies are supported: analog independent supply input for ADC, DAC, OPAMPs and comparators, 3.3 V dedicated supply input for USB and up to 14 I/Os can be supplied independently down to 1.08V. A VBAT input allows to backup the RTC and backup registers.

The STM32L476xx family offers five packages from 64-pin to 144-pin packages.

Table 2. STM32L476xx family device features and peripheral counts

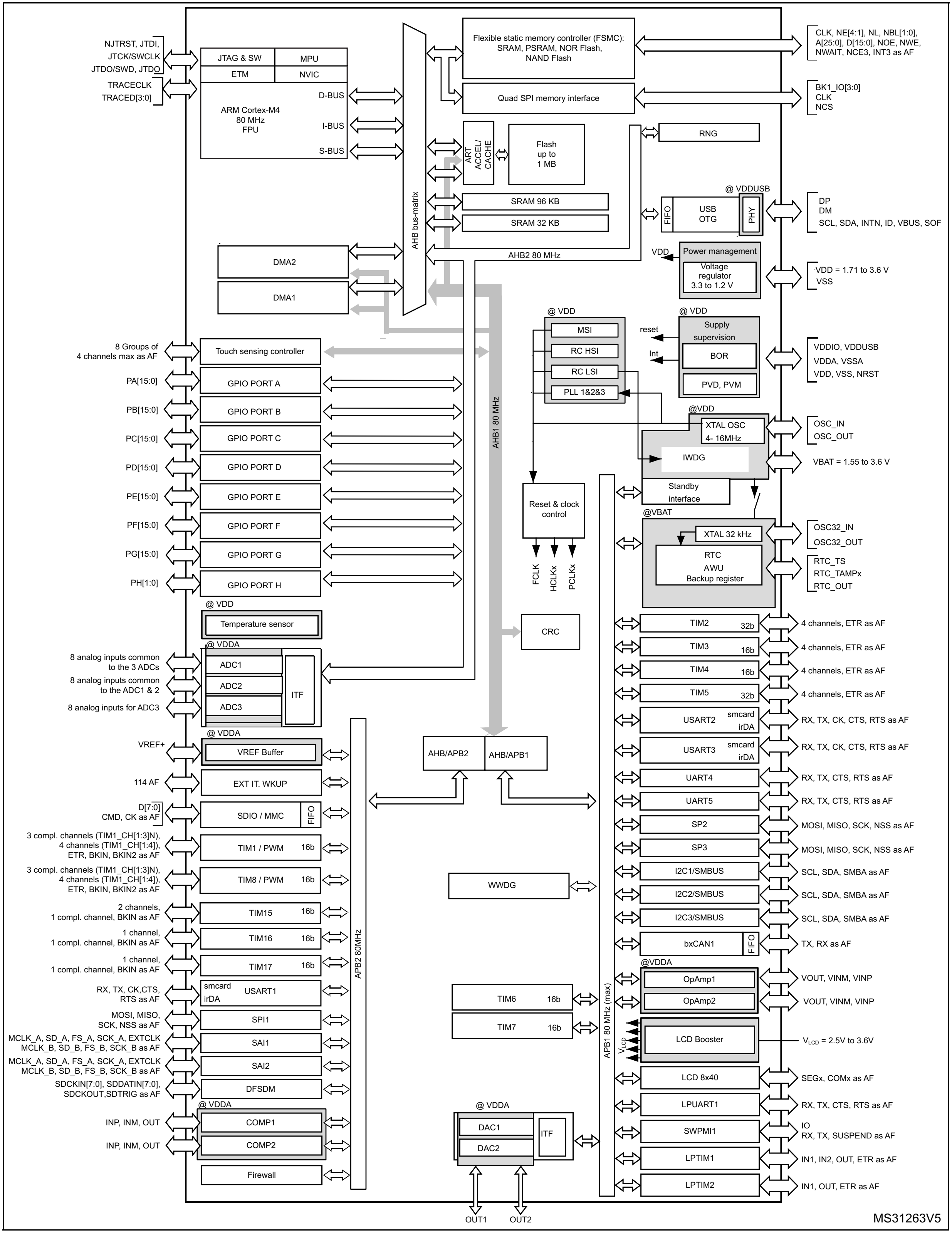
Peripheral		STM32L476Zx		STM32L476Qx		STM32L476Vx			STM32L476Jx		STM32L476Rx		
Flash memory		512KB	1MB	512KB	1MB	256KB	512KB	1MB	512KB	1MB	256KB	512KB	1MB
SRAM		128KB											
External memory controller for static memories		Yes		Yes		Yes(1)			No		No		
Quad SPI		Yes											
Timers	Advanced control	2 (16-bit)											
	General purpose	5 (16-bit) 2 (32 bit)											
	Basic	2 (16-bit)											
	Low -power	2 (16-bit)											
	SysTick timer	1											
	Watchdog timers (independent, window)	2											
Comm. interfaces	SPI	3											
	I²C	3											
	USART UART LPUART	3 2 1											
	SAI	2											
	CAN	1											
	USB OTG FS	Yes											
	SDMMC	Yes											
	SWPMI	Yes											
Digital filters for sigma-delta modulators		Yes (4 filters)											
Number of channels		8											
RTC		Yes											
Tamper pins		3							2		2		
LCD COM x SEG		Yes 8x40 or 4x44		Yes 8x40 or 4x44		Yes 8x40 or 4x44			Yes 8x28 or 4x32		Yes 8x28 or 4x32		
Random generator		Yes											
GPIOs Wakeup pins Nb of I/Os down to 1.08 V		114 5 14		109 5 14		82 5 0			57 4 6		51 4 0		
Capacitive sensing Number of channels		24		24		21			12		12		
12-bit ADCs Number of channels		3 24		3 19		3 16			3 16		3 16		
12-bit DAC channels		2											
Internal voltage reference buffer		Yes									No		
Analog comparator		2											
Operational amplifiers		2											

Table 2. STM32L476xx family device features and peripheral counts (continued)

Peripheral	STM32L476Zx	STM32L476Qx	STM32L476Vx	STM32L476Jx	STM32L476Rx
Max. CPU frequency	80 MHz				
Operating voltage	1.71 to 3.6 V				
Operating temperature	Ambient operating temperature: -40 to 85 °C / -40 to 105 °C / -40 to 125 °C Junction temperature -40 to 105 °C / -40 to 125 °C / -40 to 130 °C				
Packages	LQFP144	UFBGA132	LQFP100	WLCSP72	LQFP64

1. For the LQFP100 package, only FMC Bank1 is available. Bank1 can only support a multiplexed NOR/PSRAM memory using the NE1 Chip Select.

Figure 1. STM32L476xx block diagram



Note: AF: alternate function on I/O pins.

3 Functional overview

3.1 ARM® Cortex®-M4 core with FPU

The ARM® Cortex®-M4 with FPU processor is the latest generation of ARM processors for embedded systems. It was developed to provide a low-cost platform that meets the needs of MCU implementation, with a reduced pin count and low-power consumption, while delivering outstanding computational performance and an advanced response to interrupts.

The ARM® Cortex®-M4 with FPU 32-bit RISC processor features exceptional code-efficiency, delivering the high-performance expected from an ARM core in the memory size usually associated with 8- and 16-bit devices.

The processor supports a set of DSP instructions which allow efficient signal processing and complex algorithm execution.

Its single precision FPU speeds up software development by using metalanguage development tools, while avoiding saturation.

With its embedded ARM core, the STM32L476xx family is compatible with all ARM tools and software.

Figure 1 shows the general block diagram of the STM32L476xx family devices.

3.2 Adaptive real-time memory accelerator (ART Accelerator™)

The ART Accelerator™ is a memory accelerator which is optimized for STM32 industry-standard ARM® Cortex®-M4 processors. It balances the inherent performance advantage of the ARM® Cortex®-M4 over Flash memory technologies, which normally requires the processor to wait for the Flash memory at higher frequencies.

To release the processor near 100 DMIPS performance at 80MHz, the accelerator implements an instruction prefetch queue and branch cache, which increases program execution speed from the 64-bit Flash memory. Based on CoreMark benchmark, the performance achieved thanks to the ART accelerator is equivalent to 0 wait state program execution from Flash memory at a CPU frequency up to 80 MHz.

3.3 Memory protection unit

The memory protection unit (MPU) is used to manage the CPU accesses to memory to prevent one task to accidentally corrupt the memory or resources used by any other active task. This memory area is organized into up to 8 protected areas that can in turn be divided up into 8 subareas. The protection area sizes are between 32 bytes and the whole 4 gigabytes of addressable memory.

The MPU is especially helpful for applications where some critical or certified code has to be protected against the misbehavior of other tasks. It is usually managed by an RTOS (real-time operating system). If a program accesses a memory location that is prohibited by the MPU, the RTOS can detect it and take action. In an RTOS environment, the kernel can dynamically update the MPU area setting, based on the process to be executed.

The MPU is optional and can be bypassed for applications that do not need it.

3.4 Embedded Flash memory

STM32L476xx devices feature up to 1 Mbyte of embedded Flash memory available for storing programs and data. The Flash memory is divided into two banks allowing read-while-write operations. This feature allows to perform a read operation from one bank while an erase or program operation is performed to the other bank. The dual bank boot is also supported. Each bank contains 256 pages of 2 Kbytes.

Flexible protections can be configured thanks to option bytes:

- Readout protection (RDP) to protect the whole memory. Three levels are available:
  - Level 0: no readout protection
  - Level 1: memory readout protection: the Flash memory cannot be read from or written to if either debug features are connected, boot in RAM or bootloader is selected
  - Level 2: chip readout protection: debug features (Cortex-M4 JTAG and serial wire), boot in RAM and bootloader selection are disabled (JTAG fuse). This selection is irreversible.

Table 3. Access status versus readout protection level and execution modes

Area	Protection level	User execution			Debug, boot from RAM or boot from system memory (loader)		
		Read	Write	Erase	Read	Write	Erase
Main memory	1	Yes	Yes	Yes	No	No	No
	2	Yes	Yes	Yes	N/A	N/A	N/A
System memory	1	Yes	No	No	Yes	No	No
	2	Yes	No	No	N/A	N/A	N/A
Option bytes	1	Yes	Yes	Yes	Yes	Yes	Yes
	2	Yes	No	No	N/A	N/A	N/A
Backup registers	1	Yes	Yes	N/A(1)	No	No	N/A(1)
	2	Yes	Yes	N/A	N/A	N/A	N/A
SRAM2	1	Yes	Yes	Yes(1)	No	No	No(1)
	2	Yes	Yes	Yes	N/A	N/A	N/A

1. Erased when RDP change from Level 1 to Level 0.

- Write protection (WRP): the protected area is protected against erasing and programming. Two areas per bank can be selected, with 2-Kbyte granularity.
- Proprietary code readout protection (PCROP): a part of the flash memory can be protected against read and write from third parties. The protected area is execute-only: it can only be reached by the STM32 CPU, as an instruction code, while all other accesses (DMA, debug and CPU data read, write and erase) are strictly prohibited. One area per bank can be selected, with 64-bit granularity. An additional option bit (PCROP_RDP) allows to select if the PCROP area is erased or not when the RDP protection is changed from Level 1 to Level 0.

The whole non-volatile memory embeds the error correction code (ECC) feature supporting:

- single error detection and correction
- double error detection.
- The address of the ECC fail can be read in the ECC register

3.5 Embedded SRAM

STM32L476xx devices feature up to 128 Kbytes of embedded SRAM. This SRAM is split into two blocks:

- 96 Kbytes mapped at address 0x2000 0000 (SRAM1)
- 32 Kbytes located at address 0x1000 0000 with hardware parity check (SRAM2).

  This block is accessed through the ICode/DCode buses for maximum performance. These 32 Kbytes SRAM can also be retained in Standby mode.

  The SRAM2 can be write-protected with 1 Kbytes granularity.

The memory can be accessed in read/write at CPU clock speed with 0 wait states.

3.6 Firewall

The device embeds a Firewall which protects code sensitive and secure data from any access performed by a code executed outside of the protected areas.

Each illegal access generates a reset which kills immediately the detected intrusion.

The Firewall main features are the following:

- Three segments can be protected and defined thanks to the Firewall registers:
  - Code segment (located in Flash or SRAM1 if defined as executable protected area)
  - Non-volatile data segment (located in Flash)
  - Volatile data segment (located in SRAM1)
- The start address and the length of each segments are configurable:
  - code segment: up to 1024 KBytes with granularity of 256 bytes
  - Non-volatile data segment: up to 1024 KBytes with granularity of 256 bytes
  - Volatile data segment: up to 96 KBytes with a granularity of 64 bytes
- Specific mechanism implemented to open the Firewall to get access to the protected areas (call gate entry sequence)
- Volatile data segment can be shared or not with the non-protected code
- Volatile data segment can be executed or not depending on the Firewall configuration

The Flash readout protection must be set to level 2 in order to reach the expected level of protection.

3.7 Boot modes

At startup, BOOT0 pin and BOOT1 option bit are used to select one of three boot options:

- Boot from user Flash
- Boot from system memory
- Boot from embedded SRAM

The boot loader is located in system memory. It is used to reprogram the Flash memory by using USART, I2C, SPI and USB OTG FS in Device mode through DFU (device firmware upgrade).

3.8 Cyclic redundancy check calculation unit (CRC)

The CRC (cyclic redundancy check) calculation unit is used to get a CRC code using a configurable generator polynomial value and size.

Among other applications, CRC-based techniques are used to verify data transmission or storage integrity. In the scope of the EN/IEC 60335-1 standard, they offer a means of verifying the Flash memory integrity. The CRC calculation unit helps compute a signature of the software during runtime, to be compared with a reference signature generated at link-time and stored at a given memory location.

3.9 Power supply management

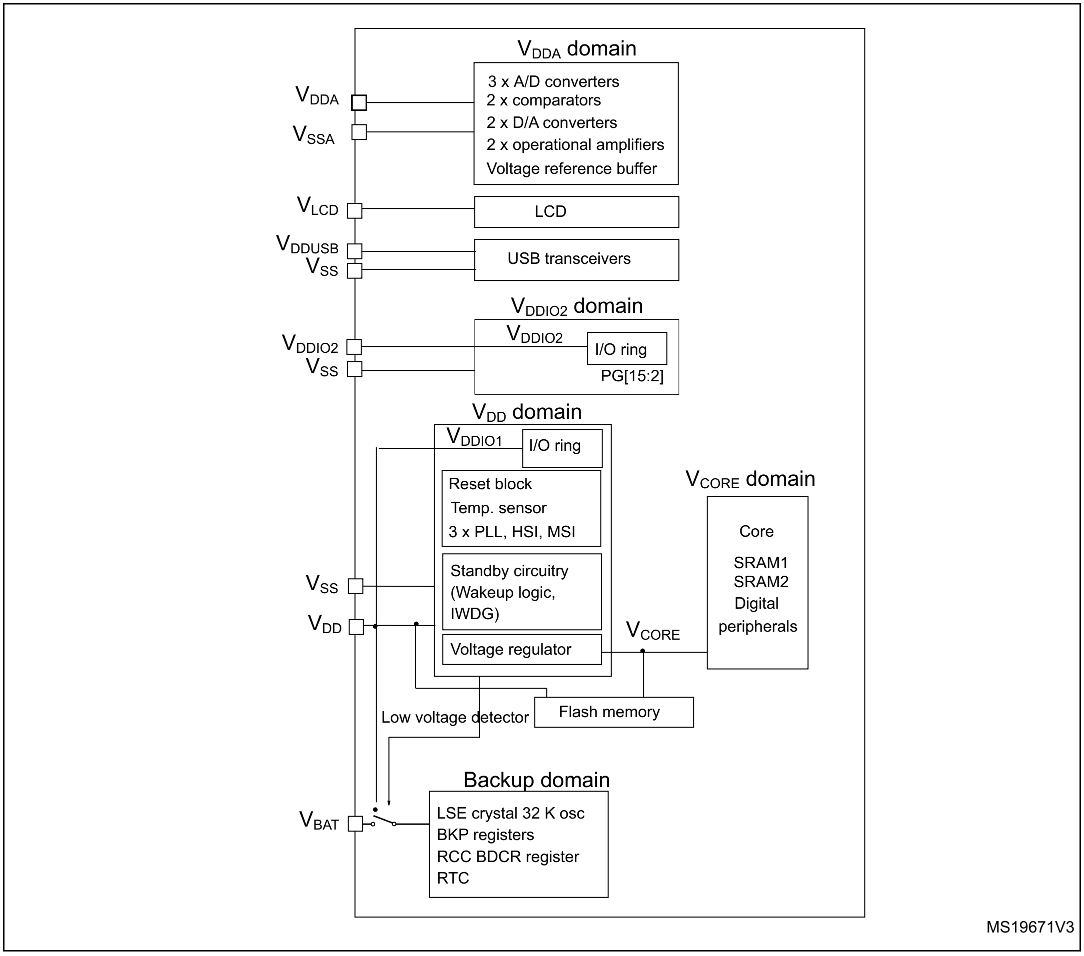
3.9.1 Power supply schemes

- V_{DD} = 1.71 to 3.6 V: external power supply for I/Os, the internal regulator and the system analog such as reset, power management and internal clocks. It is provided externally through V_{DD} pins.
- V_{DDA} = 1.62 V (ADCs/COMPs) / 1.8 (DACs/OPAMPs) to 3.6 V: external analog power supply for ADCs, DACs, OPAMPs, Comparators and Voltage reference buffer. The V_{DDA} voltage level is independent from the V_{DD} voltage.
- V_{DDUSB} = 3.0 to 3.6 V: external independent power supply for USB transceivers. The V_{DDUSB} voltage level is independent from the V_{DD} voltage.
- V_{DDIO2} = 1.08 to 3.6 V: external power supply for 14 I/Os (PG[15:2]). The V_{DDIO2} voltage level is independent from the V_{DD} voltage.
- V_{LCD} = 2.5 to 3.6 V: the LCD controller can be powered either externally through VLCD pin, or internally from an internal voltage generated by the embedded step-up converter.
- V_{BAT} = 1.55 to 3.6 V: power supply for RTC, external clock 32 kHz oscillator and backup registers (through power switch) when V_{DD} is not present.

Note: *When the functions supplied by V_{DDA}, V_{DDUSB} or V_{DDIO2} are not used, these supplies should preferably be shorted to V_{DD}.*

If these supplies are tied to ground, the I/Os supplied by these power supplies are not 5 V tolerant.

Figure 2. Power supply overview



3.9.2 Power supply supervisor

The device has an integrated ultra-low-power brown-out reset (BOR) active in all modes except Shutdown and ensuring proper operation after power-on and during power down. The device remains in reset mode when the monitored supply voltage V_{DD} is below a specified threshold, without the need for an external reset circuit.

The lowest BOR level is 1.71V at power on, and other higher thresholds can be selected through option bytes.The device features an embedded programmable voltage detector (PVD) that monitors the V_{DD} power supply and compares it to the VPVD threshold. An interrupt can be generated when V_{DD} drops below the VPVD threshold and/or when V_{DD} is higher than the VPVD 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.

In addition, the devices embeds a Peripheral Voltage Monitor which compares the independent supply voltages V_{DDA}, V_{DDUSB}, V_{DDIO2} with a fixed threshold in order to ensure that the peripheral is in its functional supply range.

3.9.3 Voltage regulator

Two embedded linear voltage regulators supply most of the digital circuitries: the main regulator (MR) and the low-power regulator (LPR).

- The MR is used in the Run and Sleep modes
- The LPR is used in Low-Power Run, Low-Power Sleep, Stop 1 and Stop 2 modes. It is also used to supply the 32 Kbytes SRAM2 in Standby with RAM2 retention.
- Both regulators are in power-down in Standby and Shutdown modes: the regulator output is in high impedance, and the kernel circuitry is powered down thus inducing zero consumption.

The ultralow-power STM32L476xx supports dynamic voltage scaling to optimize its power consumption in run mode. The voltage from the Main Regulator that supplies the logic (VCORE) can be adjusted according to the system’s maximum operating frequency.

There are two power consumption ranges:

- Range 1 with the CPU running at up to 80 MHz.
- Range 2 with a maximum CPU frequency of 26 MHz. All peripheral clocks are also limited to 26 MHz.

The VCORE can be supplied by the low-power regulator, the main regulator being switched off. The system is then in Low-power run mode.

- Low-power run mode with the CPU running at up to 2 MHz. Peripherals with independent clock can be clocked by HSI.

3.9.4 Low-power modes

The ultra-low-power STM32L476xx supports seven low-power modes to achieve the best compromise between low-power consumption, short startup time, available peripherals and available wakeup sources:

Table 4. STM32L476 modes overview

Mode	Regulator(1)	CPU	Flash	SRAM	Clocks	DMA & Peripherals(2)	Wakeup source	Consumption(3)	Wakeup time
Run	Range 1	Yes	ON(4)	ON	Any	All	N/A	112 µA/MHz	N/A
	Range2					All except OTG_FS, SDMMC, RNG		100 µA/MHz	
LPRun	LPR	Yes	ON(4)	ON	Any except PLL	All except OTG, SDMMC, RNG	N/A	136 µA/MHz	TBD
Sleep	Range 1	No	ON(4)	ON(5)	Any	All	Any interrupt or event	37 µA/MHz	6 cycles
	Range 2							35 µA/MHz	6 cycles
LPSleep	LPR	No	ON(4)	ON(5)	Any except PLL	All except OTG, SDMMC, RNG	Any interrupt or event	40 µA/MHz	6 cycles
Stop 1	LPR	No	Off	ON	LSE LSI	BOR, PVD, PVM RTC, LCD, IWDG COMPx (x=1,2) DACx (x=1,2) OPAMPx (x=1,2) USARTx (x=1...5)(6) LPUART1(6) I2Cx (x=1...3)(7) LPTIMx (x=1,2) *** All other peripherals are frozen.	Reset pin, all I/Os BOR, PVD, PVM RTC, LCD, IWDG COMPx (x=1..2) USARTx (x=1...5)(6) LPUART1(6) I2Cx (x=1...3)(7) LPTIMx (x=1,2) OTG_FS(8) SWPMI(9)	7.3 µA w/o RTC 7.6 µA w RTC	4 µs in SRAM 6 µs in Flash

Table 4. STM32L476 modes overview (continued)

Mode	Regulator (1)	CPU	Flash	SRAM	Clocks	DMA & Peripherals(2)	Wakeup source	Consumption(3)	Wakeup time
Stop 2	LPR	No	Off	ON	LSE LSI	BOR, PVD, PVM RTC, LCD, IWDG COMPx (x=1..2) I2C3(7) LPUART1(6) LPTIM1 *** All other peripherals are frozen.	Reset pin, all I/Os BOR, PVD, PVM RTC, LCD, IWDG COMPx (x=1..2) I2C3(7) LPUART1(6) LPTIM1	1.1 µA w/o RTC 1.4 µA w/RTC	5 µs in SRAM 7 µs in Flash
Standby	LPR	Powered Off	Off	SRAM2 ON	LSE LSI	BOR, RTC, IWDG *** All other peripherals are powered off. *** I/O configuration can be floating, pull-up or pull-down	Reset pin 5 I/Os (WKUPx)(10) BOR, RTC, IWDG	0.36 µA w/o RTC 0.66 µA w/ RTC	14 µs
	OFF			Powered Off				0.13 µA w/o RTC 0.43 µA w/ RTC	
Shutdown	OFF	Powered Off	Off	Powered Off	LSE	RTC *** All other peripherals are powered off. *** I/O configuration can be floating, pull-up or pull-down(11)	Reset pin 5 I/Os (WKUPx)(10) RTC	0.03 µA w/o RTC 0.33 µA w/ RTC	256 µs

1. LPR means Main regulator is OFF and Low-power regulator is ON.
2. All peripherals can be active or clock gated to save power consumption.
3. Typical current at V_{DD} = 1.8 V, 25°C. Consumptions values provided running from SRAM, Flash memory Off, 80 MHz in Range 1, 26 MHz in Range 2, 2 MHz in LPRun/LPSleep.
4. The Flash memory can be put in power-down and its clock can be gated off when executing from SRAM.
5. The SRAM1 and SRAM2 clocks can be gated on or off independently.
6. U(S)ART and LPUART reception is functional in Stop mode, and generates a wakeup interrupt on Start, address match or received frame event.
7. I2C address detection is functional in Stop mode, and generates a wakeup interrupt in case of address match.
8. OTG_FS wakeup by resume from suspend and attach detection protocol event.

9. SWPMI wakeup by resume from suspend.
10. The I/Os with wakeup from Standby/Shutdown capability are: PA0, PC13, PE6, PA2, PC5.
11. I/Os can be configured with internal pull-up, pull-down or floating in Shutdown mode but the configuration is lost when exiting the Shutdown mode.

By default, the microcontroller is in Run mode after a system or a power Reset. It is up to the user to select one of the low-power modes described below:

- **Sleep** mode

  In Sleep mode, only the CPU is stopped. All peripherals continue to operate and can wake up the CPU when an interrupt/event occurs.
- **Low-power run** mode

  This mode is achieved with VCORE supplied by the low-power regulator to minimize the regulator's operating current. The code can be executed from SRAM or from Flash, and the CPU frequency is limited to 2 MHz. The peripherals with independent clock can be clocked by HSI.
- **Low-power sleep** mode

  This mode is entered from the low-power run mode. Only the CPU clock is stopped. When wakeup is triggered by an event or an interrupt, the system reverts to the low-power run mode.
- **Stop 1 and Stop 2** modes

  Stop mode achieves the lowest power consumption while retaining the content of SRAM and registers. All clocks in the VCORE domain are stopped, the PLL, the MSI RC, the HSI RC and the HSE crystal oscillators are disabled. The LSE or LSI is still running.

  The RTC can remain active (Stop mode with RTC, Stop mode without RTC).

  Some peripherals with wakeup capability can enable the HSI RC during Stop mode to detect their wakeup condition.

  Two Stop modes are available: Stop 1 and Stop 2 modes. In Stop 2 mode, most of the VCORE domain is put in a lower leakage mode.

  Stop 1 offers the largest number of active peripherals and wakeup sources, a smaller wakeup time but a higher consumption than Stop 2.

  The system clock when exiting from Stop1 or Stop2 modes can be either MSI up to 48 MHz or HSI, depending on software configuration.
- **Standby** mode

  The Standby mode is used to achieve the lowest power consumption with BOR. The internal regulator is switched off so that the VCORE domain is powered off. The PLL, the MSI RC, the HSI RC and the HSE crystal oscillators are also switched off.

  The RTC can remain active (Standby mode with RTC, Standby mode without RTC).

  The brown-out reset (BOR) always remains active in Standby mode.

  The state of each I/O during standby mode can be selected by software: I/O with internal pull-up, internal pull-down or floating.

  After entering Standby mode, SRAM1 and register contents are lost except for registers in the Backup domain and Standby circuitry. Optionally, SRAM2 can be retained in

Standby mode, supplied by the low-power Regulator (Standby with RAM2 retention mode).

The device exits Standby mode when an external reset (NRST pin), an IWDG reset, WKUP pin event (configurable rising or falling edge), or an RTC event occurs (alarm, periodic wakeup, timestamp, tamper) or a failure is detected on LSE (CSS on LSE).

The system clock after wakeup is MSI up to 8 MHz.

- **Shutdown** mode

  The Shutdown mode allows to achieve the lowest power consumption. The internal regulator is switched off so that the VCORE domain is powered off. The PLL, the HSI, the MSI, the LSI and the HSE oscillators are also switched off.

  The RTC can remain active (Shutdown mode with RTC, Shutdown mode without RTC).

  The BOR is not available in Shutdown mode. No power voltage monitoring is possible in this mode, therefore the switch to Backup domain is not supported.

  SRAM1, SRAM2 and register contents are lost except for registers in the Backup domain.

  The device exits Shutdown mode when an external reset (NRST pin), a WKUP pin event (configurable rising or falling edge), or an RTC event occurs (alarm, periodic wakeup, timestamp, tamper).

  The system clock after wakeup is MSI at 4 MHz.

Table 5. Functionalities depending on the working mode(1)

Peripheral	Run	Sleep	Low-power run	Low-power sleep	Stop 1		Stop 2		Standby		Shutdown		VBAT
					-	Wakeup capability	-	Wakeup capability	-	Wakeup capability	-	Wakeup capability	
CPU	Y	-	Y	-	-	-	-	-	-	-	-	-	-
Flash memory (up to 1 MB)	O(2)	O(2)	O(2)	O(2)	-	-	-	-	-	-	-	-	-
SRAM1 (up to 96 KB)	Y	Y(3)	Y	Y(3)	Y	-	Y	-	-	-	-	-	-
SRAM2 (32 KB)	Y	Y(3)	Y	Y(3)	Y	-	Y	-	O(4)	-	-	-	-
FSMC	O	O	O	O	-	-	-	-	-	-	-	-	-
QUADSPI	O	O	O	O	-	-	-	-	-	-	-	-	-
Backup Registers	Y	Y	Y	Y	Y	-	Y	-	Y	-	Y	-	Y
Brown-out reset (BOR)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	-	-
Programmable Voltage Detector (PVD)	O	O	O	O	O	O	O	O	-	-	-	-	-
Peripheral Voltage Monitor (PVMx; x=1,2,3,4)	O	O	O	O	O	O	O	O	-	-	-	-	-
DMA	O	O	O	O	-	-	-	-	-	-	-	-	-
High Speed Internal (HSI)	O	O	O	O	(5)	-	(5)	-	-	-	-	-	-
High Speed External (HSE)	O	O	O	O	-	-	-	-	-	-	-	-	-
Low Speed Internal (LSI)	O	O	O	O	O	-	O	-	O	-	-	-	-
Low Speed External (LSE)	O	O	O	O	O	-	O	-	O	-	O	-	O
Multi-Speed Internal (MSI)	O	O	O	O	-	-	-	-	-	-	-	-	-
Clock Security System (CSS)	O	O	O	O	-	-	-	-	-	-	-	-	-
Clock Security System on LSE	O	O	O	O	O	O	O	O	O	O	-	-	-
RTC / Auto wakeup	O	O	O	O	O	O	O	O	O	O	O	O	O
Number of RTC Tamper pins	3	3	3	3	3	O	3	O	3	O	3	O	3

Table 5. Functionalities depending on the working mode(1) (continued)

Peripheral	Run	Sleep	Low-power run	Low-power sleep	Stop 1		Stop 2		Standby		Shutdown		VBAT
					-	Wakeup capability	-	Wakeup capability	-	Wakeup capability	-	Wakeup capability	
LCD	O	O	O	O	O	O	O	O	-	-	-	-	-
USB OTG FS	O	O	-	-	-	O	-	-	-	-	-	-	-
USARTx (x=1,2,3,4,5)	O	O	O	O	O(6)	O(6)	-	-	-	-	-	-	-
Low-power UART (LPUART)	O	O	O	O	O(6)	O(6)	O(6)	O(6)	-	-	-	-	-
I2Cx (x=1,2)	O	O	O	O	O(7)	O(7)	-	-	-	-	-	-	-
I2C3	O	O	O	O	O(7)	O(7)	O(7)	O(7)	-	-	-	-	-
SPIx (x=1,2,3)	O	O	O	O	-	-	-	-	-	-	-	-	-
CAN	O	O	O	O	-	-	-	-	-	-	-	-	-
SDMMC	O	O	-	-	-	-	-	-	-	-	-	-	-
SWPMI	O	O	O	O	-	O	-	-	-	-	-	-	-
SAIx (x=1,2)	O	O	O	O	-	-	-	-	-	-	-	-	-
DFSDM	O	O	O	O	-	-	-	-	-	-	-	-	-
ADCx (x=1,2,3)	O	O	O	O	-	-	-	-	-	-	-	-	-
DACx (x=1,2)	O	O	O	O	O	-	-	-	-	-	-	-	-
OPAMPx (x=1,2)	O	O	O	O	O	-	-	-	-	-	-	-	-
COMPx (x=1,2)	O	O	O	O	O	O	O	O	-	-	-	-	-
Temperature sensor	O	O	O	O	-	-	-	-	-	-	-	-	-
Timers (TIMx)	O	O	O	O	-	-	-	-	-	-	-	-	-
Low-power timer 1 (LPTIM1)	O	O	O	O	O	O	O	O	-	-	-	-	-
Low-power timer 2 (LPTIM2)	O	O	O	O	O	O	-	-	-	-	-	-	-
Independent watchdog (IWDG)	O	O	O	O	O	O	O	O	O	O	-	-	-
Window watchdog (WWDG)	O	O	O	O	-	-	-	-	-	-	-	-	-
SysTick timer	O	O	O	O	-	-	-	-	-	-	-	-	-
Touch sensing controller (TSC)	O	O	O	O	-	-	-	-	-	-	-	-	-

Table 5. Functionalities depending on the working mode(1) (continued)

Peripheral	Run	Sleep	Low-power run	Low-power sleep	Stop 1		Stop 2		Standby		Shutdown		VBAT
					-	Wakeup capability	-	Wakeup capability	-	Wakeup capability	-	Wakeup capability	
Random number generator (RNG)	O	O	-	-	-	-	-	-	-	-	-	-	-
CRC calculation unit	O	O	O	O	-	-	-	-	-	-	-	-	-
GPIOs	O	O	O	O	O	O	O	O	(8)	5 pins (9)	(10)	5 pins (9)	-

1. Legend: Y = Yes (Enable). O = Optional (Disable by default. Can be enabled by software). - = Not available.
2. The Flash can be configured in power-down mode. By default, it is not in power-down mode.
3. The SRAM clock can be gated on or off.
4. SRAM2 content is preserved when the bit RRS is set in PWR_CR3 register.
5. Some peripherals with wakeup from Stop capability can request HSI to be enabled. In this case, HSI is woken up by the peripheral, and only feeds the peripheral which requested it. HSI is automatically put off when the peripheral does not need it anymore.
6. UART and LPUART reception is functional in Stop mode, and generates a wakeup interrupt on Start, address match or received frame event.
7. I2C address detection is functional in Stop mode, and generates a wakeup interrupt in case of address match.
8. I/Os can be configured with internal pull-up, pull-down or floating in Standby mode.
9. The I/Os with wakeup from Standby/Shutdown capability are: PA0, PC13, PE6, PA2, PC5.
10. I/Os can be configured with internal pull-up, pull-down or floating in Shutdown mode but the configuration is lost when exiting the Shutdown mode.

3.9.5 Reset mode

In order to improve the consumption under reset, the I/Os state under and after reset is "analog state" (the I/O schmitt trigger is disable). In addition, the internal reset pull-up is deactivated when the reset source is internal.

3.9.6 VBAT operation

The VBAT pin allows to power the device VBAT domain from an external battery, an external supercapacitor, or from V_{DD} when no external battery and an external supercapacitor are present. The VBAT pin supplies the RTC with LSE and the backup registers. Three anti-tamper detection pins are available in VBAT mode.

VBAT operation is automatically activated when V_{DD} is not present.

An internal VBAT battery charging circuit is embedded and can be activated when V_{DD} is present.

Note: *When the microcontroller is supplied from VBAT, external interrupts and RTC alarm/events do not exit it from VBAT operation.*

3.10 Interconnect matrix

Several peripherals have direct connections between them. This allows autonomous communication between peripherals, saving CPU resources thus power supply consumption. In addition, these hardware connections allow fast and predictable latency.

Depending on peripherals, these interconnections can operate in Run, Sleep, low-power run and sleep, Stop 1 and Stop 2 modes.

Table 6. STM32L476xx peripherals interconnect matrix

Interconnect source	Interconnect destination	Interconnect action	Run	Sleep	Low-power run	Low-power sleep	Stop 1	Stop 2
TIMx	TIMx	Timers synchronization or chaining	Y	Y	Y	Y	-	-
	ADCx DACx DFSDM	Conversion triggers	Y	Y	Y	Y	-	-
	DMA	Memory to memory transfer trigger	Y	Y	Y	Y	-	-
	COMPx	Comparator output blanking	Y	Y	Y	Y	-	-
COMPx	TIM1, 8 TIM2, 3	Timer input channel, trigger, break from analog signals comparison	Y	Y	Y	Y	-	-
	LPTIMERx	Low-power timer triggered by analog signals comparison	Y	Y	Y	Y	Y	Y
ADCx	TIM1, 8	Timer triggered by analog watchdog	Y	Y	Y	Y	-	-
RTC	TIM16	Timer input channel from RTC events	Y	Y	Y	Y	-	-
	LPTIMERx	Low-power timer triggered by RTC alarms or tampers	Y	Y	Y	Y	Y	Y (1)
All clocks sources (internal and external)	TIM2 TIM15, 16, 17	Clock source used as input channel for RC measurement and trimming	Y	Y	Y	Y	-	-
USB	TIM2	Timer triggered by USB SOF	Y	Y	-	-	-	-
CSS CPU (hard fault) RAM (parity error) Flash memory (ECC error) COMPx PVD DFSDM (analog watchdog, short circuit detection)	TIM1,8 TIM15,16,17	Timer break	Y	Y	Y	Y	-	-

Table 6. STM32L476xx peripherals interconnect matrix (continued)

Interconnect source	Interconnect destination	Interconnect action	Run	Sleep	Low-power run	Low-power sleep	Stop 1	Stop 2
GPIO	TIMx	External trigger	Y	Y	Y	Y	-	-
	LPTIMERx	External trigger	Y	Y	Y	Y	Y	Y
	ADCx DACx DFSDM	Conversion external trigger	Y	Y	Y	Y	-	-

1. LPTIM1 only.

3.11 Clocks and startup

The clock controller (see *Figure 3*) distributes the clocks coming from different oscillators to the core and the peripherals. It also manages clock gating for low-power modes and ensures clock robustness. It features:

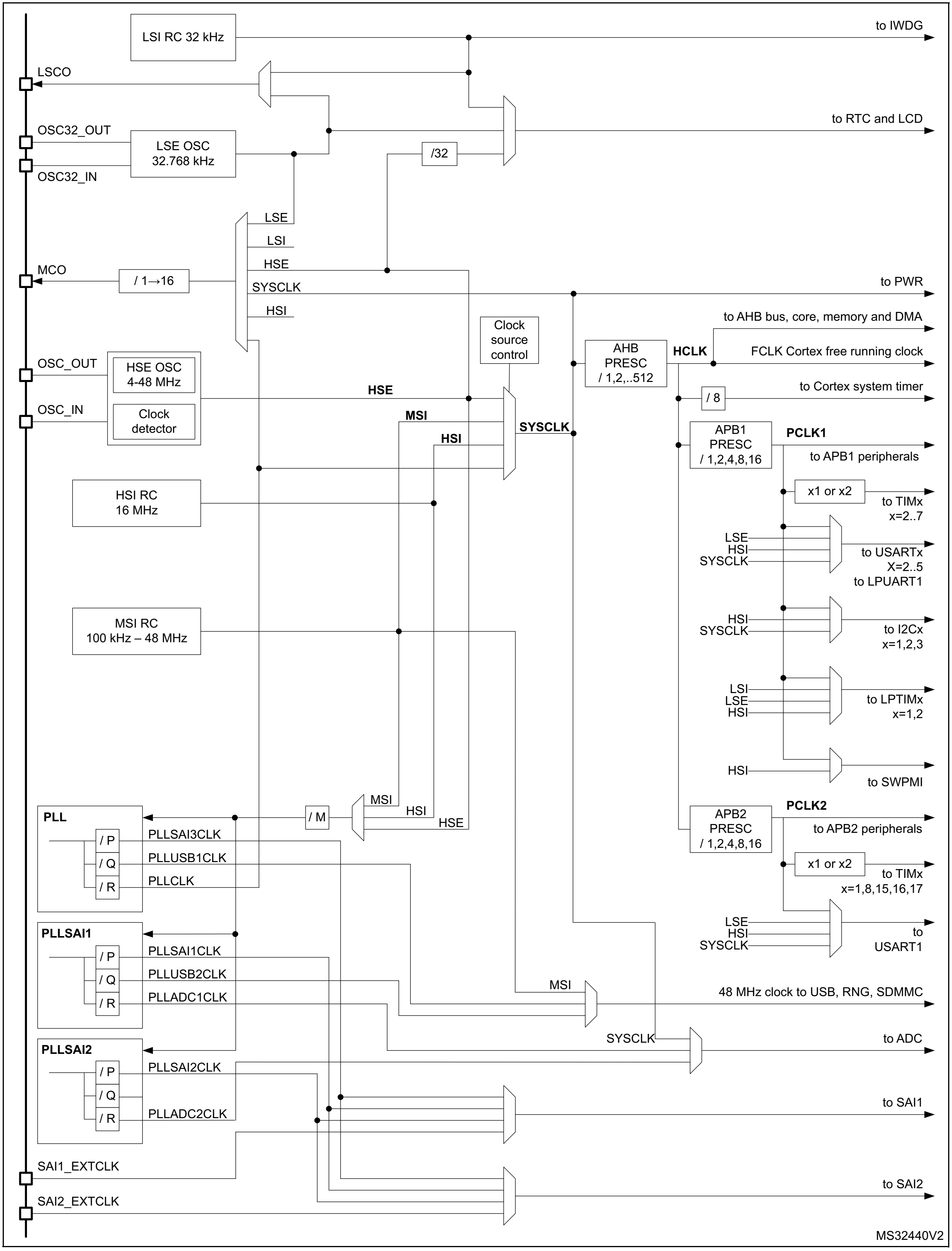
- **Clock prescaler:** to get the best trade-off between speed and current consumption, the clock frequency to the CPU and peripherals can be adjusted by a programmable prescaler
- **Safe clock switching:** clock sources can be changed safely on the fly in run mode through a configuration register.
- **Clock management:** to reduce power consumption, the clock controller can stop the clock to the core, individual peripherals or memory.
- **System clock source:** four different clock sources can be used to drive the master clock SYSCLK:
  - 4-48 MHz high-speed external crystal or ceramic resonator (HSE), that can supply a PLL. The HSE can also be configured in bypass mode for an external clock.
  - 16 MHz high-speed internal RC oscillator (HSI), trimmable by software, that can supply a PLL
  - Multispeed internal RC oscillator (MSI), trimmable by software, able to generate 12 frequencies from 100 kHz to 48 MHz. When a 32.768 kHz clock source is available in the system (LSE), the MSI frequency can be automatically trimmed by hardware to reach better than ±0.25% accuracy. In this mode the MSI can feed the USB device, saving the need of an external high-speed crystal (HSE). The MSI can supply a PLL.
  - System PLL which can be fed by HSE, HSI or MSI, with a maximum frequency at 80 MHz.
- **Auxiliary clock source:** two ultralow-power clock sources that can be used to drive the LCD controller and the real-time clock:
  - 32.768 kHz low-speed external crystal (LSE), supporting four drive capability modes. The LSE can also be configured in bypass mode for an external clock.
  - 32 kHz low-speed internal RC (LSI), also used to drive the independent watchdog. The LSI clock accuracy is ±5% accuracy.
- **Peripheral clock sources:** Several peripherals (USB, SDMMC, RNG, SAI, USARTs, I2Cs, LPTimers, ADC, SWPMI) have their own independent clock whatever the system clock. Three PLLs, each having three independent outputs allowing the highest flexibility, can generate independent clocks for the ADC, the USB/SDMMC/RNG and the two SAIs.
- **Startup clock:** after reset, the microcontroller restarts by default with an internal 4 MHz clock (MSI). 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 master clock is automatically switched to HSI and a software

interrupt is generated if enabled. LSE failure can also be detected and generated an interrupt.

- Clock-out capability:
  - **MCO: microcontroller clock output:** it outputs one of the internal clocks for external use by the application
  - **LSCO: low speed clock output:** it outputs LSI or LSE in all low-power modes (except VBAT).

Several prescalers allow to configure the AHB frequency, the high speed APB (APB2) and the low speed APB (APB1) domains. The maximum frequency of the AHB and the APB domains is 80 MHz.

Figure 3. Clock tree



3.12 General-purpose inputs/outputs (GPIOs)

Each of the GPIO pins can be configured by software as output (push-pull or open-drain), as input (with or without pull-up or pull-down) or as peripheral alternate function. Most of the GPIO pins are shared with digital or analog alternate functions. Fast I/O toggling can be achieved thanks to their mapping on the AHB2 bus.

The I/Os alternate function configuration can be locked if needed following a specific sequence in order to avoid spurious writing to the I/Os registers.

3.13 Direct memory access controller (DMA)

The device embeds 2 DMAs. Refer to *Table 7: DMA implementation* for the features implementation.

Direct memory access (DMA) is used in order to provide high-speed data transfer between peripherals and memory as well as memory to memory. Data can be quickly moved by DMA without any CPU actions. This keeps CPU resources free for other operations.

The two DMA controllers have 14 channels in total, each dedicated to managing memory access requests from one or more peripherals. Each has an arbiter for handling the priority between DMA requests.

The DMA supports:

- 14 independently configurable channels (requests)
- Each channel is connected to dedicated hardware DMA requests, software trigger is also supported on each channel. This configuration is done by software.
- Priorities between requests from channels of one DMA are software programmable (4 levels consisting of very high, high, medium, low) or hardware in case of equality (request 1 has priority over request 2, etc.)
- Independent source and destination transfer size (byte, half word, word), emulating packing and unpacking. Source/destination addresses must be aligned on the data size.
- Support for circular buffer management
- 3 event flags (DMA Half Transfer, DMA Transfer complete and DMA Transfer Error) logically ORed together in a single interrupt request for each channel
- Memory-to-memory transfer
- Peripheral-to-memory and memory-to-peripheral, and peripheral-to-peripheral transfers
- Access to Flash, SRAM, APB and AHB peripherals as source and destination
- Programmable number of data to be transferred: up to 65536.

Table 7. DMA implementation

DMA features	DMA1	DMA2
Number of regular channels	7	7

3.14 Interrupts and events

3.14.1 Nested vectored interrupt controller (NVIC)

The devices embed a nested vectored interrupt controller able to manage 16 priority levels, and handle up to 81 maskable interrupt channels plus the 16 interrupt lines of the Cortex®-M4.

The NVIC benefits are the following:

- Closely coupled NVIC gives low latency interrupt processing
- Interrupt entry vector table address passed directly to the core
- Allows early processing of interrupts
- Processing of late arriving higher priority interrupts
- Support for tail chaining
- Processor state automatically saved
- Interrupt entry restored on interrupt exit with no instruction overhead

The NVIC hardware block provides flexible interrupt management features with minimal interrupt latency.

3.14.2 Extended interrupt/event controller (EXTI)

The extended interrupt/event controller consists of 36 edge detector lines used to generate interrupt/event requests and wake-up the system from Stop mode. Each external line can be independently configured to select the trigger event (rising edge, falling edge, both) and can be masked independently A pending register maintains the status of the interrupt requests. The internal lines are connected to peripherals with wakeup from Stop mode capability. The EXTI can detect an external line with a pulse width shorter than the internal clock period. Up to 114 GPIOs can be connected to the 16 external interrupt lines.

3.15 Analog to digital converter (ADC)

The device embeds 3 successive approximation analog-to-digital converters with the following features:

- 12-bit native resolution, with built-in calibration
- 5 Msps maximum conversion rate with full resolution
  - Down to 18.75 ns sampling time
  - Increased conversion rate for lower resolution (up to 8.75 Msps for 6-bit resolution)
- Up to 24 external channels, some of them shared between ADC1 and ADC2, or ADC1, ADC2 and ADC3.
- 5 Internal channels: internal reference voltage, temperature sensor, VBAT/3, DAC1 and DAC2 outputs.
- One external reference pin is available on some package, allowing the input voltage range to be independent from the power supply
- Single-ended and differential mode inputs
- Low-power design
  - Capable of low-current operation at low conversion rate (consumption decreases linearly with speed)
  - Dual clock domain architecture: ADC speed independent from CPU frequency
- Highly versatile digital interface
  - Single-shot or continuous/discontinuous sequencer-based scan mode: 2 groups of analog signals conversions can be programmed to differentiate background and high-priority real-time conversions
  - Handles two ADC converters for dual mode operation (simultaneous or interleaved sampling modes)
  - Each ADC support multiple trigger inputs for synchronization with on-chip timers and external signals
  - Results stored into 3 data register or in RAM with DMA controller support
  - Data pre-processing: left/right alignment and per channel offset compensation
  - Built-in oversampling unit for enhanced SNR
  - Channel-wise programmable sampling time
  - Three analog watchdog for automatic voltage monitoring, generating interrupts and trigger for selected timers
  - Hardware assistant to prepare the context of the injected channels to allow fast context switching

3.15.1 Temperature sensor

The temperature sensor (TS) generates a voltage VSENSE that varies linearly with temperature.

The temperature sensor is internally connected to the ADC1_IN17 and ADC3_IN17 input channels which is used to convert the sensor output voltage into a digital value.

The sensor provides good linearity but it has to be calibrated to obtain good overall accuracy of the temperature measurement. As the offset of the temperature sensor varies from chip to chip due to process variation, the uncalibrated internal temperature sensor is suitable for applications that detect temperature changes only.

To improve the accuracy of the temperature sensor measurement, each device is individually factory-calibrated by ST. The temperature sensor factory calibration data are stored by ST in the system memory area, accessible in read-only mode.

Table 8. Temperature sensor calibration values

Calibration value name	Description	Memory address
TS_CAL1	TS ADC raw data acquired at a temperature of 30 °C (± 5 °C), $V_{DDA} = V_{REF+} = 3.0$ V (± 10 mV)	0x1FFF 75A8 - 0x1FFF 75A9
TS_CAL2	TS ADC raw data acquired at a temperature of 110 °C (± 5 °C), $V_{DDA} = V_{REF+} = 3.0$ V (± 10 mV)	0x1FFF 75CA - 0x1FFF 75CB

3.15.2 Internal voltage reference (V_{REFINT})

The internal voltage reference (VREFINT) provides a stable (bandgap) voltage output for the ADC and Comparators. VREFINT is internally connected to the ADC1_IN0 input channel. The precise voltage of VREFINT is individually measured for each part by ST during production test and stored in the system memory area. It is accessible in read-only mode.

Table 9. Internal voltage reference calibration values

Calibration value name	Description	Memory address
VREFINT	Raw data acquired at a temperature of 30 °C (± 5 °C), $V_{DDA} = V_{REF+} = 3.0$ V (± 10 mV)	0x1FFF 75AA - 0x1FFF 75AB

3.15.3 V_{BAT} battery voltage monitoring

This embedded hardware feature allows the application to measure the V_{BAT} battery voltage using the internal ADC channel ADC1_IN18 or ADC3_IN18. As the V_{BAT} voltage may be higher than VDDA, and thus outside the ADC input range, the VBAT pin is internally connected to a bridge divider by 3. As a consequence, the converted digital value is one third the V_{BAT} voltage.

3.16 Digital to analog converter (DAC)

Two 12-bit buffered DAC channels can be used to convert digital signals into analog voltage signal outputs. The chosen design structure is composed of integrated resistor strings and an amplifier in inverting configuration.

This digital interface supports the following features:

- Up to two DAC output channels
- 8-bit or 12-bit monotonic output
- Buffer offset calibration (factory and user trimming)

- Left or right data alignment in 12-bit mode
- Synchronized update capability
- Noise-wave generation
- Triangular-wave generation
- Dual DAC channel independent or simultaneous conversions
- DMA capability for each channel
- External triggers for conversion
- Sample and hold low-power mode, with internal or external capacitor

The DAC channels are triggered through the timer update outputs that are also connected to different DMA channels.

3.17 Voltage reference buffer (VREFBUF)

The STM32L476xx devices embed an voltage reference buffer which can be used as voltage reference for ADCs, DACs and also as voltage reference for external components through the VREF+ pin.

The internal voltage reference buffer supports two voltages:

- 2.048V
- 2.5V.

An external voltage reference can be provided through the VREF+ pin when the internal voltage reference buffer is off.

The VREF+ pin is double-bonded with VDDA on some packages. In these packages the internal voltage reference buffer is not available.

3.18 Comparators (COMP)

The STM32L476xx devices embed two rail-to-rail comparators with programmable reference voltage (internal or external), hysteresis and speed (low speed for low-power) and with selectable output polarity.

The reference voltage can be one of the following:

- External I/O
- DAC output channels
- Internal reference voltage or submultiple (1/4, 1/2, 3/4).

All comparators can wake up from Stop mode, generate interrupts and breaks for the timers and can be also combined into a window comparator.

3.19 Operational amplifier (OPAMP)

The STM32L476xx embeds two operational amplifiers with external or internal follower routing and PGA capability. When an operational amplifier is selected, an external ADC channel is used to enable output measurement.

The operational amplifier features:

- Low input bias current
- Low offset voltage
- Low-power mode
- Rail-to-rail input

3.20 Touch sensing controller (TSC)

The touch sensing controller provides 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 (glass, 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.

The touch sensing controller is fully supported by the STMTouch touch sensing firmware library which is free to use and allows touch sensing functionality to be implemented reliably in the end application.

The main features of the touch sensing controller are the following:

- Proven and robust surface charge transfer acquisition principle
- Supports up to 24 capacitive sensing channels
- Up to 3 capacitive sensing channels can be acquired in parallel offering a very good response time
- Spread spectrum feature to improve system robustness in noisy environments
- Full hardware management of the charge transfer acquisition sequence
- Programmable charge transfer frequency
- Programmable sampling capacitor I/O pin
- Programmable channel I/O pin
- Programmable max count value to avoid long acquisition when a channel is faulty
- Dedicated end of acquisition and max count error flags with interrupt capability
- One sampling capacitor for up to 3 capacitive sensing channels to reduce the system components
- Compatible with proximity, touchkey, linear and rotary touch sensor implementation
- Designed to operate with STMTouch touch sensing firmware library

Note: The number of capacitive sensing channels is dependent on the size of the packages and subject to I/O availability.

3.21 Liquid crystal display controller (LCD)

The LCD drives up to 8 common terminals and 44 segment terminals to drive up to 320 pixels.

- Internal step-up converter to guarantee functionality and contrast control irrespective of V_{DD}. This converter can be deactivated, in which case the VLCD pin is used to provide the voltage to the LCD
- Supports static, 1/2, 1/3, 1/4 and 1/8 duty
- Supports static, 1/2, 1/3 and 1/4 bias
- Phase inversion to reduce power consumption and EMI
- Integrated voltage output buffers for higher LCD driving capability
- Up to 8 pixels can be programmed to blink
- Unneeded segments and common pins can be used as general I/O pins
- LCD RAM can be updated at any time owing to a double-buffer
- The LCD controller can operate in Stop mode

3.22 Digital filter for Sigma-Delta Modulators (DFSDM)

The device embeds one DFSDM with 4 digital filters modules and 8 external input serial channels (transceivers) or alternately 8 internal parallel inputs support.

The DFSDM peripheral is dedicated to interface the external ΣΔ modulators to microcontroller and then to perform digital filtering of the received data streams (which represent analog value on ΣΔ modulators inputs). DFSDM can also interface PDM (Pulse Density Modulation) microphones and perform PDM to PCM conversion and filtering in hardware. DFSDM features optional parallel data stream inputs from microcontrollers memory (through DMA/CPU transfers into DFSDM).

DFSDM transceivers support several serial interface formats (to support various ΣΔ modulators). DFSDM digital filter modules perform digital processing according user selected filter parameters with up to 24-bit final ADC resolution.

The DFSDM peripheral supports:

- 8 multiplexed input digital serial channels:
  - configurable SPI interface to connect various SD modulator(s)
  - configurable Manchester coded 1 wire interface support
  - PDM (Pulse Density Modulation) microphone input support
  - maximum input clock frequency up to 20 MHz (10 MHz for Manchester coding)
  - clock output for SD modulator(s): 0..20 MHz
- alternative inputs from 8 internal digital parallel channels (up to 16 bit input resolution):
  - internal sources: device memory data streams (DMA)
- 4 digital filter modules with adjustable digital signal processing:
  - Sinc^{x} filter: filter order/type (1..5), oversampling ratio (up to 1..1024)
  - integrator: oversampling ratio (1..256)
- up to 24-bit output data resolution, signed output data format
- automatic data offset correction (offset stored in register by user)
- continuous or single conversion
- start-of-conversion triggered by:
  - software trigger
  - internal timers
  - external events
  - start-of-conversion synchronously with first digital filter module (DFSDM0)
- analog watchdog feature:
  - low value and high value data threshold registers
  - dedicated configurable Sincx digital filter (order = 1..3, oversampling ratio = 1..32)
  - input from final output data or from selected input digital serial channels
  - continuous monitoring independently from standard conversion
- short circuit detector to detect saturated analog input values (bottom and top range):
  - up to 8-bit counter to detect 1..256 consecutive 0’s or 1’s on serial data stream
  - monitoring continuously each input serial channel
- break signal generation on analog watchdog event or on short circuit detector event
- extremes detector:
  - storage of minimum and maximum values of final conversion data
  - refreshed by software
- DMA capability to read the final conversion data
- interrupts: end of conversion, overrun, analog watchdog, short circuit, input serial channel clock absence
- “regular” or “injected” conversions:
  - “regular” conversions can be requested at any time or even in continuous mode without having any impact on the timing of “injected” conversions
  - “injected” conversions for precise timing and with high conversion priority

3.23 Random number generator (RNG)

All devices embed an RNG that delivers 32-bit random numbers generated by an integrated analog circuit.

3.24 Timers and watchdogs

The STM32L4x includes two advanced control timers, up to nine general-purpose timers, two basic timers, two low-power timers, two watchdog timers and a SysTick timer. The table below compares the features of the advanced control, general purpose and basic timers.

Table 10. Timer feature comparison

Timer type	Timer	Counter resolution	Counter type	Prescaler factor	DMA request generation	Capture/ compare channels	Complementary outputs
Advanced control	TIM1, TIM8	16-bit	Up, down, Up/down	Any integer between 1 and 65536	Yes	4	3
General-purpose	TIM2, TIM5	32-bit	Up, down, Up/down	Any integer between 1 and 65536	Yes	4	No
General-purpose	TIM3, TIM4	16-bit	Up, down, Up/down	Any integer between 1 and 65536	Yes	4	No
General-purpose	TIM15	16-bit	Up	Any integer between 1 and 65536	Yes	2	1
General-purpose	TIM16, TIM17	16-bit	Up	Any integer between 1 and 65536	Yes	1	1
Basic	TIM6, TIM7	16-bit	Up	Any integer between 1 and 65536	Yes	0	No

3.24.1 Advanced-control timer (TIM1, TIM8)

The advanced-control timer can each be seen as a three-phase PWM multiplexed on 6 channels. They have complementary PWM outputs with programmable inserted dead-times. They can also be seen as complete general-purpose timers. The 4 independent channels can be used for:

- Input capture
- Output compare
- PWM generation (edge or center-aligned modes) with full modulation capability (0-100%)
- One-pulse mode output

In debug mode, the advanced-control timer counter can be frozen and the PWM outputs disabled to turn off any power switches driven by these outputs.

Many features are shared with those of the general-purpose TIMx timers (described in *Chapter 3.24.2* using the same architecture, so the advanced-control timers can work together with the TIMx timers via the Timer Link feature for synchronization or event chaining.

3.24.2 General-purpose timers (TIM2, TIM3, TIM4, TIM5, TIM15, TIM16, TIM17)

There are up to seven synchronizable general-purpose timers embedded in the STM32L4x (see *Table 10* for differences). Each general-purpose timer can be used to generate PWM outputs, or act as a simple time base.

- TIM2, TIM3, TIM4 and TIM5

  They are full-featured general-purpose timers:

  - TIM2 and TIM5 have a 32-bit auto-reload up/downcounter and 32-bit prescaler
  - TIM3 and TIM4 has 16-bit auto-reload up/downcounter and 16-bit prescaler.

  These timers feature 4 independent channels for input capture/output compare, PWM or one-pulse mode output. They can work together, or with the other general-purpose timers via the Timer Link feature for synchronization or event chaining.

  The counters can be frozen in debug mode.

  All have independent DMA request generation and support quadrature encoders.

- TIM15, 16 and 17

  They are general-purpose timers with mid-range features:

  They have 16-bit auto-reload upcounters and 16-bit prescalers.

  - TIM15 has 2 channels and 1 complementary channel
  - TIM16 and TIM17 have 1 channel and 1 complementary channel

  All channels can be used for input capture/output compare, PWM or one-pulse mode output.

  The timers can work together via the Timer Link feature for synchronization or event chaining. The timers have independent DMA request generation.

  The counters can be frozen in debug mode.

3.24.3 Basic timers (TIM6 and TIM7)

The basic timers are mainly used for DAC trigger generation. They can also be used as generic 16-bit timebases.

3.24.4 Low-power timer (LPTIM1 and LPTIM2)

The devices embed two low-power timers. These timers have an independent clock and are running in Stop mode if they are clocked by LSE, LSI or an external clock. They are able to wakeup the system from Stop mode.

LPTIM1 is active in Stop 1 and Stop 2 modes.

LPTIM2 is active in Stop 1 mode.

This low-power timer supports the following features:

- 16-bit up counter with 16-bit autoreload register
- 16-bit compare register
- Configurable output: pulse, PWM
- Continuous/ one shot mode
- Selectable software/hardware input trigger
- Selectable clock source
    - Internal clock sources: LSE, LSI,HSI or APB clock
    - External clock source over LPTIM input (working even with no internal clock source running, used by pulse counter application).
- Programmable digital glitch filter
- Encoder mode (LPTIM1 only)

3.24.5 Independent watchdog (IWDG)

The independent watchdog is based on a 12-bit downcounter and 8-bit prescaler. It is clocked from an independent 32 kHz internal RC (LSI) and as it operates independently from the main clock, it can operate in Stop and Standby modes. It can be used either as a watchdog to reset the device when a problem occurs, or as a free running timer for application timeout management. It is hardware or software configurable through the option bytes. The counter can be frozen in debug mode.

3.24.6 System window watchdog (WWDG)

The window watchdog is based on a 7-bit downcounter that can be set as free running. It can be used as a watchdog to reset the device when a problem occurs. It is clocked from the main clock. It has an early warning interrupt capability and the counter can be frozen in debug mode.

3.24.7 SysTick timer

This timer is dedicated to real-time operating systems, but could also be used as a standard down counter. It features:

- A 24-bit down counter
- Autoreload capability
- Maskable system interrupt generation when the counter reaches 0.
- Programmable clock source

3.25 Real-time clock (RTC) and backup registers

The RTC is an independent BCD timer/counter. It supports the following features:

- Calendar with subsecond, seconds, minutes, hours (12 or 24 format), week day, date, month, year, in BCD (binary-coded decimal) format.
- Automatic correction for 28, 29 (leap year), 30, and 31 days of the month.
- Two programmable alarms.
- On-the-fly correction from 1 to 32767 RTC clock pulses. This can be used to synchronize it with a master clock.
- Reference clock detection: a more precise second source clock (50 or 60 Hz) can be used to enhance the calendar precision.
- Digital calibration circuit with 0.95 ppm resolution, to compensate for quartz crystal inaccuracy.
- Three anti-tamper detection pins with programmable filter.
- Timestamp feature which can be used to save the calendar content. This function can be triggered by an event on the timestamp pin, or by a tamper event, or by a switch to VBAT mode.
- 17-bit auto-reload wakeup timer (WUT) for periodic events with programmable resolution and period.

The RTC and the 32 backup registers are supplied through a switch that takes power either from the V_{DD} supply when present or from the VBAT pin.

The backup registers are 32-bit registers used to store 128 bytes of user application data when VDD power is not present. They are not reset by a system or power reset, or when the device wakes up from Standby or Shutdown mode.

The RTC clock sources can be:

- A 32.768 kHz external crystal (LSE)
- An external resonator or oscillator (LSE)
- The internal low power RC oscillator (LSI, with typical frequency of 32 kHz)
- The high-speed external clock (HSE) divided by 32.

The RTC is functional in VBAT mode and in all low-power modes when it is clocked by the LSE. When clocked by the LSI, the RTC is not functional in VBAT mode, but is functional in all low-power modes except Shutdown mode.

All RTC events (Alarm, WakeUp Timer, Timestamp or Tamper) can generate an interrupt and wakeup the device from the low-power modes.

3.26 Inter-integrated circuit interface (I2C)

The device embeds *3* I2C. Refer to *Table 11: I2C implementation* for the features implementation.

The I^2C bus interface handles communications between the microcontroller and the serial I^2C bus. It controls all I^2C bus-specific sequencing, protocol, arbitration and timing.

The I2C peripheral supports:

- I^2C-bus specification and user manual rev. 5 compatibility:
  - Slave and master modes, multimaster capability
  - Standard-mode (Sm), with a bitrate up to 100 kbit/s
  - Fast-mode (Fm), with a bitrate up to 400 kbit/s
  - Fast-mode Plus (Fm+), with a bitrate up to 1 Mbit/s and 20 mA output drive I/Os
  - 7-bit and 10-bit addressing mode, multiple 7-bit slave addresses
  - Programmable setup and hold times
  - Optional clock stretching
- System Management Bus (SMBus) specification rev 2.0 compatibility:
  - Hardware PEC (Packet Error Checking) generation and verification with ACK control
  - Address resolution protocol (ARP) support
  - SMBus alert
- Power System Management Protocol (PMBus^{TM}) specification rev 1.1 compatibility
- Independent clock: a choice of independent clock sources allowing the I2C communication speed to be independent from the PCLK reprogramming. Refer to *Figure 3: Clock tree*.
- Wakeup from Stop mode on address match
- Programmable analog and digital noise filters
- 1-byte buffer with DMA capability

Table 11. I2C implementation

I2C features[1]	I2C1	I2C2	I2C3
Standard-mode (up to 100 kbit/s)	X	X	X
Fast-mode (up to 400 kbit/s)	X	X	X
Fast-mode Plus with 20mA output drive I/Os (up to 1 Mbit/s)	X	X	X
Programmable analog and digital noise filters	X	X	X
SMBus/PMBus hardware support	X	X	X
Independent clock	X	X	X
Wakeup from Stop 1 mode on address match	X	X	X
Wakeup from Stop 2 mode on address match	-	-	X

1. X: supported

3.27 Universal synchronous/asynchronous receiver transmitter (USART)

The STM32L476xx devices have three embedded universal synchronous receiver transmitters (USART1, USART2 and USART3) and two universal asynchronous receiver transmitters (UART4, UART5).

These interfaces provide asynchronous communication, IrDA SIR ENDEC support, multiprocessor communication mode, single-wire half-duplex communication mode and have LIN Master/Slave capability. They provide hardware management of the CTS and RTS signals, and RS485 Driver Enable. They are able to communicate at speeds of up to 10Mbit/s.

USART1, USART2 and USART3 also provide Smart Card mode (ISO 7816 compliant) and SPI-like communication capability.

All USART have a clock domain independent from the CPU clock, allowing the USARTx (x=1,2,3,4,5) to wake up the MCU from Stop mode.The wake up events from Stop mode are programmable and can be:

- Start bit detection
- Any received data frame
- A specific programmed data frame

All USART interfaces can be served by the DMA controller.

3.28 Low-power universal asynchronous receiver transmitter (LPUART)

The device embeds one Low-Power UART. The LPUART supports asynchronous serial communication with minimum power consumption. It supports half duplex single wire communication and modem operations (CTS/RTS). It allows multiprocessor communication.

The LPUART has a clock domain independent from the CPU clock, and can wakeup the system from Stop mode. The wake up events from Stop mode are programmable and can be:

- Start bit detection
- Any received data frame
- A specific programmed data frame

Only a 32.768 kHz clock (LSE) is needed to allow LPUART communication up to 9600 baud. Therefore, even in Stop mode, the LPUART can wait for an incoming frame while having an extremely low energy consumption. Higher speed clock can be used to reach higher baudrates.

LPUART interface can be served by the DMA controller.

3.29 Serial peripheral interface (SPI)

Three SPI interfaces allow communication up to 40 Mbits/s in master and up to 24 Mbits/s slave modes, in half-duplex, full-duplex and simplex modes. The 3-bit prescaler gives 8 master mode frequencies and the frame size is configurable from 4 bits to 16 bits. The SPI interfaces support NSS pulse mode, TI mode and Hardware CRC calculation.

All SPI interfaces can be served by the DMA controller.

3.30 Serial audio interfaces (SAI)

The device embeds 2 SAI. Refer to table *Table 12: SAI implementation* for the features implementation. The SAI bus interface handles communications between the microcontroller and the serial audio protocol.

The SAI peripheral supports:

- Two independent audio sub-blocks which can be transmitters or receivers with their respective FIFO.
- 8-word integrated FIFOs for each audio sub-block.
- Synchronous or asynchronous mode between the audio sub-blocks.
- Master or slave configuration independent for both audio sub-blocks.
- Clock generator for each audio block to target independent audio frequency sampling when both audio sub-blocks are configured in master mode.
- Data size configurable: 8-, 10-, 16-, 20-, 24-, 32-bit.
- Peripheral with large configurability and flexibility allowing to target as example the following audio protocol: I2S, LSB or MSB-justified, PCM/DSP, TDM, AC’97 and SPDIF out.
- Up to 16 slots available with configurable size and with the possibility to select which ones are active in the audio frame.
- Number of bits by frame may be configurable.
- Frame synchronization active level configurable (offset, bit length, level).
- First active bit position in the slot is configurable.
- LSB first or MSB first for data transfer.
- Mute mode.
- Stereo/Mono audio frame capability.
- Communication clock strobing edge configurable (SCK).
- Error flags with associated interrupts if enabled respectively.
  - Overrun and underrun detection,
  - Anticipated frame synchronization signal detection in slave mode,
  - Late frame synchronization signal detection in slave mode,
  - Codec not ready for the AC’97 mode in reception.
- Interruption sources when enabled:
  - Errors,
  - FIFO requests.
- DMA interface with 2 dedicated channels to handle access to the dedicated integrated FIFO of each SAI audio sub-block.

Table 12. SAI implementation

SAI features[1]	SAI1	SAI2
I2S, LSB or MSB-justified, PCM/DSP, TDM, AC’97	X	X
Mute mode	X	X
Stereo/Mono audio frame capability.	X	X
16 slots	X	X

Table 12. SAI implementation

SAI features[1]	SAI1	SAI2
Data size configurable: 8-, 10-, 16-, 20-, 24-, 32-bit	X	X
FIFO Size	X (8 Word)	X (8 Word)
SPDIF	X	X

1. X: supported

3.31 Single wire protocol master interface (SWPMI)

The Single wire protocol master interface (SWPMI) is the master interface corresponding to the Contactless Frontend (CLF) defined in the ETSI TS 102 613 technical specification. The main features are:

- full-duplex communication mode
- automatic SWP bus state management (active, suspend, resume)
- configurable bitrate up to 2 Mbit/s
- automatic SOF, EOF and CRC handling

SWPMI can be served by the DMA controller.

3.32 Controller area network (CAN)

The CAN is compliant with specifications 2.0A and B (active) with a bit rate up to 1 Mbit/s. It can receive and transmit standard frames with 11-bit identifiers as well as extended frames with 29-bit identifiers. It has three transmit mailboxes, two receive FIFOs with 3 stages and 14 scalable filter banks.

The CAN peripheral supports:

- Supports CAN protocol version 2.0 A, B Active
- Bit rates up to 1 Mbit/s
- Transmission
  - Three transmit mailboxes
  - Configurable transmit priority
- Reception
  - Two receive FIFOs with three stages
  - 14 Scalable filter banks:
  - Identifier list feature
  - Configurable FIFO overrun
- Time-triggered communication option
  - Disable automatic retransmission mode
  - 16-bit free running timer
  - Time Stamp sent in last two data bytes
- Management
  - Maskable interrupts
  - Software-efficient mailbox mapping at a unique address space

3.33 Secure digital input/output and MultiMediaCards Interface (SDMMC)

The card host interface (SDMMC) provides an interface between the APB peripheral bus and MultiMediaCards (MMCs), SD memory cards and SDIO cards.

The SDMMC features include the following:

- Full compliance with MultiMediaCard System Specification Version 4.2. Card support for three different databus modes: 1-bit (default), 4-bit and 8-bit
- Full compatibility with previous versions of MultiMediaCards (forward compatibility)
- Full compliance with SD Memory Card Specifications Version 2.0
- Full compliance with SD I/O Card Specification Version 2.0: card support for two different databus modes: 1-bit (default) and 4-bit
- Data transfer up to 48 MHz for the 8 bit mode
- Data write and read with DMA capability

3.34 Universal serial bus on-the-go full-speed (OTG_FS)

The devices embed an USB OTG full-speed device/host/OTG peripheral with integrated transceivers. The USB OTG FS peripheral is compliant with the USB 2.0 specification and with the OTG 2.0 specification. It has software-configurable endpoint setting and supports suspend/resume. The USB OTG controller requires a dedicated 48 MHz clock that can be provided by the internal multispeed oscillator (MSI) automatically trimmed by 32.768 kHz external oscillator (LSE).This allows to use the USB device without external high speed crystal (HSE).

The major features are:

- Combined Rx and Tx FIFO size of 1.25 KB with dynamic FIFO sizing
- Supports the session request protocol (SRP) and host negotiation protocol (HNP)
- 1 bidirectional control endpoint + 5 IN endpoints + 5 OUT endpoints
- 8 host channels with periodic OUT support
- HNP/SNP/IP inside (no need for any external resistor)
- Software configurable to OTG 1.3 and OTG 2.0 modes of operation
- OTG 2.0 Supports ADP (Attach detection Protocol)
- USB 2.0 LPM (Link Power Management) support
- Battery Charging Specification Revision 1.2 support
- Internal FS OTG PHY support

For OTG/Host modes, a power switch is needed in case bus-powered devices are connected.

3.35 Flexible static memory controller (FSMC)

The Flexible static memory controller (FSMC) includes two memory controllers:

- The NOR/PSRAM memory controller
- The NAND/memory controller

This memory controller is also named Flexible memory controller (FMC).

The main features of the FMC controller are the following:

- Interface with static-memory mapped devices including:
  - Static random access memory (SRAM)
  - NOR Flash memory/OneNAND Flash memory
  - PSRAM (4 memory banks)
  - NAND Flash memory with ECC hardware to check up to 8 Kbytes of data
- 8-,16- bit data bus width
- Independent Chip Select control for each memory bank
- Independent configuration for each memory bank
- Write FIFO
- The Maximum FMC_CLK frequency for synchronous accesses is HCLK/2.

LCD parallel interface

The FMC can be configured to interface seamlessly with most graphic LCD controllers. It supports the Intel 8080 and Motorola 6800 modes, and is flexible enough to adapt to specific LCD interfaces. This LCD parallel interface capability makes it easy to build cost effective graphic applications using LCD modules with embedded controllers or high performance solutions using external controllers with dedicated acceleration.

3.36 Quad SPI memory interface (QUADSPI)

The QuadSPI is a specialized communication interface targeting single, dual or quad SPI flash memories. It can operate in any of the three following modes:

- Indirect mode: all the operations are performed using the QuadSPI registers
- Status polling mode: the external flash status register is periodically read and an interrupt can be generated in case of flag setting
- Memory-mapped mode: the external flash is memory mapped and is seen by the system as if it were an internal memory

The QuadSPI interface supports:

- Three functional modes: indirect, status-polling, and memory-mapped
- Dual-flash mode, where 8 bits can be sent/received simultaneously by accessing two flash memories in parallel.
- SDR and DDR support
- Fully programmable opcode for both indirect and memory mapped mode
- Fully programmable frame format for both indirect and memory mapped mode
- Each of the 5 following phases can be configured independently (enable, length, single/dual/quad communication)
  - Instruction phase
  - Address phase
  - Alternate bytes phase
  - Dummy cycles phase
  - Data phase
- Integrated FIFO for reception and transmission
- 8, 16, and 32-bit data accesses are allowed
- DMA channel for indirect mode operations
- Programmable masking for external flash flag management
- Timeout management
- Interrupt generation on FIFO threshold, timeout, status match, operation complete, and access error

3.37 Development support

3.37.1 Serial wire JTAG debug port (SWJ-DP)

The ARM SWJ-DP interface is embedded, and is a combined JTAG and serial wire debug port that enables either a serial wire debug or a JTAG probe to be connected to the target.

Debug is performed using 2 pins only instead of 5 required by the JTAG (JTAG pins could be re-use as GPIO with alternate function): the JTAG TMS and TCK pins are shared with SWDIO and SWCLK, respectively, and a specific sequence on the TMS pin is used to switch between JTAG-DP and SW-DP.

3.37.2 Embedded Trace Macrocell™

The ARM Embedded Trace Macrocell provides a greater visibility of the instruction and data flow inside the CPU core by streaming compressed data at a very high rate from the STM32L476xx through a small number of ETM pins to an external hardware trace port analyzer (TPA) device. Real-time instruction and data flow activity be recorded and then formatted for display on the host computer that runs the debugger software. TPA hardware is commercially available from common development tool vendors.

The Embedded Trace Macrocell operates with third party debugger software tools.

4 Pinouts and pin description

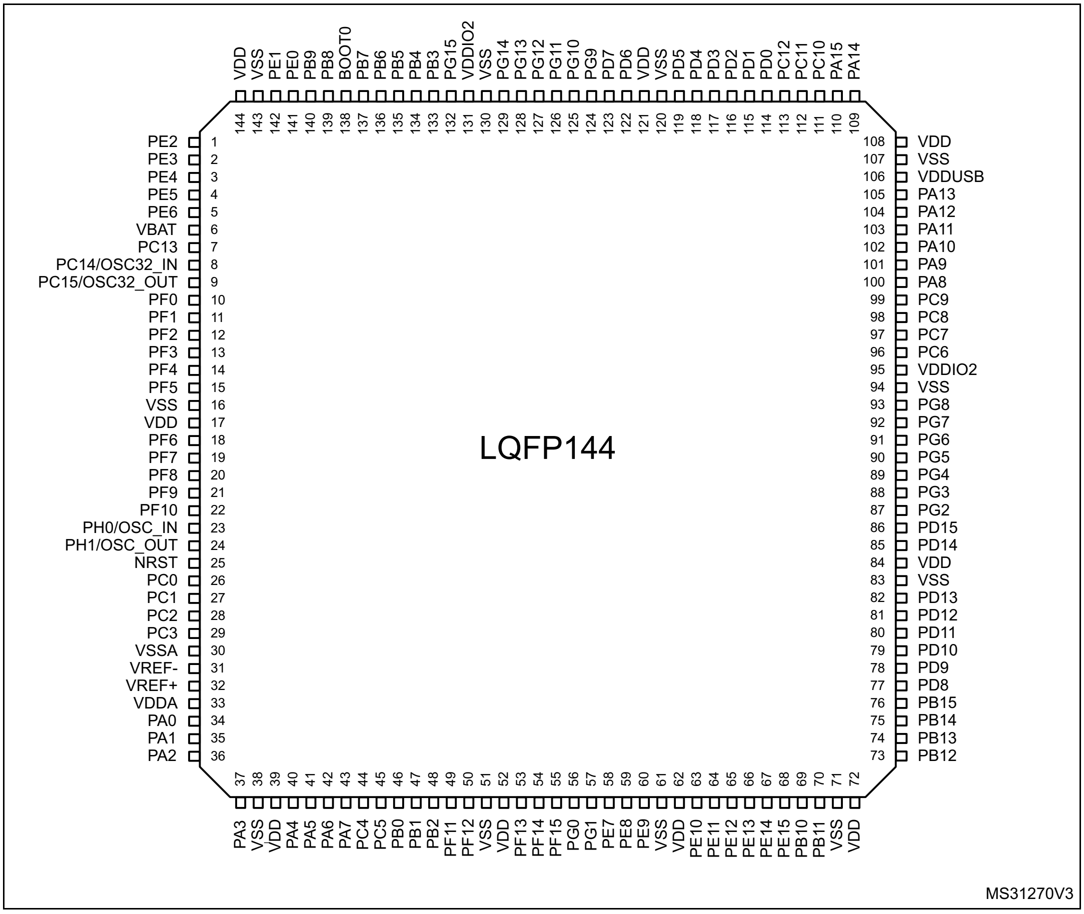


Figure 4. STM32L476Zx LQFP144 pinout[1]

1. The above figure shows the package top view.

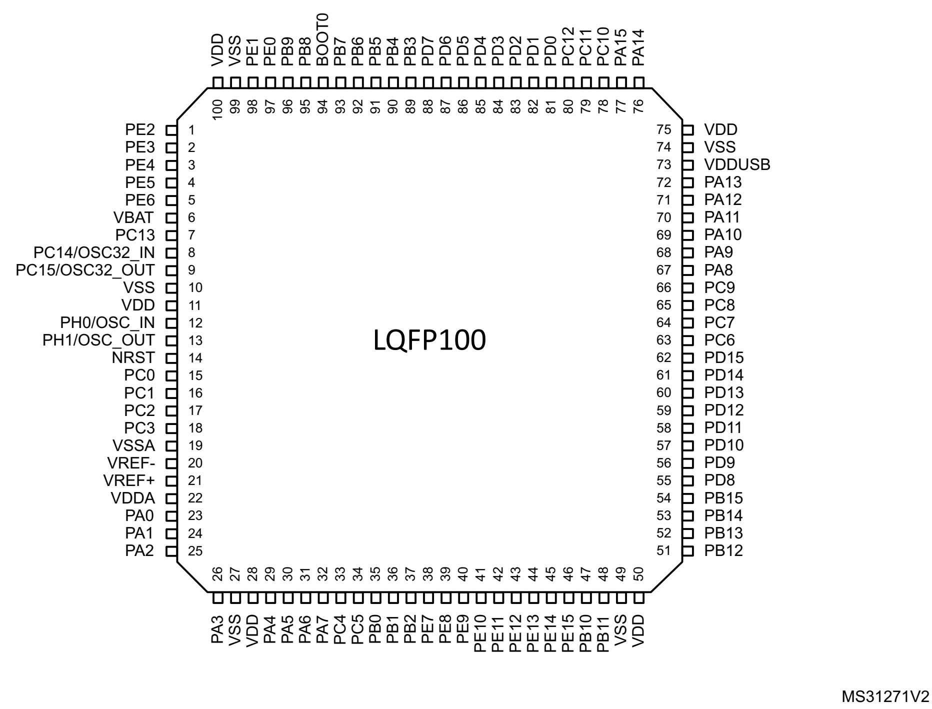
Figure 5. STM32L476xx UFBGA132 ballout[(1)]

	1	2	3	4	5	6	7	8	9	10	11	12
A	PE3	PE1	PB8	BOOT0	PD7	PD5	PB4	PB3	PA15	PA14	PA13	PA12
B	PE4	PE2	PB9	PB7	PB6	PD6	PD4	PD3	PD1	PC12	PC10	PA11
C	PC13	PE5	PE0	VDD	PB5	PG14	PG13	PD2	PD0	PC11	VDDUSB	PA10
D	PC14 OSC32_IN	PE6	VSS	PF2	PF1	PF0	PG12	PG10	PG9	PA9	PA8	PC9
E	PC15 OSC32_OUT	VBAT	VSS	PF3					PG5	PC8	PC7	PC6
F	PH0 OSC_IN	VSS	PF4	PF5		VSS	VSSIO2		PG3	PG4	VSS	VSS
G	PH1 OSC_OUT	VDD	PG11	PG6		VDD	VDDIO2		PG1	PG2	VDD	VDD
H	PC0	NRST	VDD	PG7					PG0	PD15	PD14	PD13
J	VSSA	PC1	PC2	PA4	PA7	PG8	PF12	PF14	PF15	PD12	PD11	PD10
K	PG15	PC3 VLCD	PA2	PA5	PC4	PF11	PF13	PD9	PD8	PB15	PB14	PB13
L	VREF+	PA0	PA3	PA6	PC5	PB2	PE8	PE10	PE12	PB10	PB11	PB12
M	VDDA	PA1	OPAMP1_VINM	OPAMP2_VINM	PB0	PB1	PE7	PE9	PE11	PE13	PE14	PE15

MSv35003V2

1. The above figure shows the package top view.

Figure 6. STM32L476xx LQFP100 pinout[(1)]



1. The above figure shows the package top view.

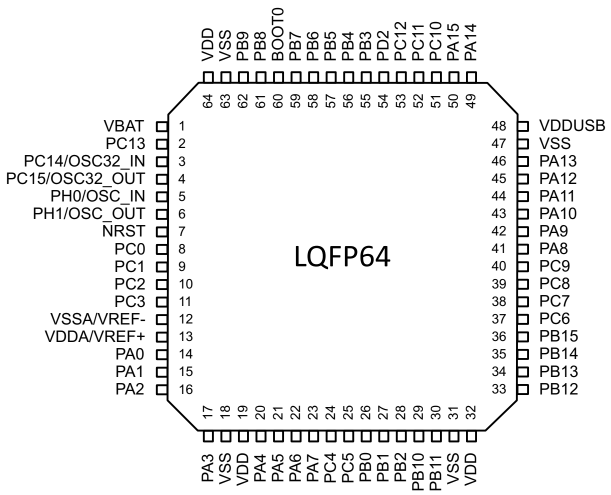
Figure 7. STM32L476xx WLCSP72 ballout(1)

	1	2	3	4	5	6	7	8	9
A	VDDUSB	PA15	PD2	PG9	PG14	PB3	PB7	VSS	VDD
B	VSS	PA14	PC12	PG10	PG13	VDDIO2	PB6	PC13	VBAT
C	PA12	PA13	PC11	PG11	PG12	PB4	PB5	PC15 OSC32_OUT	PC14 OSC32_IN
D	PA11	PA10	PC10				BOOT0	PH1 OSC_OUT	PH0 OSC_IN
E	PC9	PA8	PA9				PB8	PB9	NRST
F	PC7	PC8	PC6				PC2	PC1	PC0
G	PB15	PB14	PB11	PA1	PA4	PA2	PC3 VLCD	VREF+	VSSA
H	PB12	PB13	PB10	PA7	PA6	PA5	PA3	PA0	VDDA
J	VDD	VSS	PB2	PB1	PB0	PC5	PC4	VDD	VSS

MSv35083V1

1. The above figure shows the package top view.

Figure 8. STM32L476xx LQFP64 pinout(1)



MS31272V3

1. The above figure shows the package top view.

Table 13. Legend/abbreviations used in the pinout table

Name		Abbreviation	Definition
Pin name		Unless otherwise specified in brackets below the pin name, the pin function during and after reset is the same as the actual pin name	
Pin type		S	Supply pin
		I	Input only pin
		I/O	Input / output pin
I/O structure		FT	5 V tolerant I/O
		TT	3.6 V tolerant I/O
		B	Dedicated BOOT0 pin
		RST	Bidirectional reset pin with embedded weak pull-up resistor
		Abbreviation includes "f"(1)	I/O, Fm+ capable
		Abbreviation includes "l"(2)	I/O, with LCD function supplied by V_{LCD}
		Abbreviation includes "u"(3)	I/O, with USB function supplied by V_{DDUSB}
		Abbreviation includes "a"(4)	I/O, with Analog switch function supplied by V_{DDA}
		Abbreviation includes "s"(5)	I/O supplied by V_{DDIO2}
Notes		Unless otherwise specified by a note, all I/Os are set as analog inputs during and after reset.	
Pin functions	Alternate functions	Functions selected through GPIOx_AFR registers	
	Additional functions	Functions directly selected/enabled through peripheral registers	

1. The related I/O structures in *Table 14* are: FT_f, FT_fa, FT_fl, FT_fla.
2. The related I/O structures in *Table 14* are: FT_l, FT_fl, FT_lu.
3. The related I/O structures in *Table 14* are: FT_u, FT_lu.
4. The related I/O structures in *Table 14* are: FT_a, FT_la, FT_fa, FT_fla, TT_a, TT_la.
5. The related I/O structures in *Table 14* are: FT_s, FT_fs.

Table 14. STM32L476xx pin definitions

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	-	1	B2	1	PE2	I/O	FT_l	-	TRACECK, TIM3_ETR, TSC_G7_IO1, LCD_SEG38, FMC_A23, SAI1_MCLK_A, EVENTOUT	-
-	-	2	A1	2	PE3	I/O	FT_l	-	TRACED0, TIM3_CH1, TSC_G7_IO2, LCD_SEG39, FMC_A19, SAI1_SD_B, EVENTOUT	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	-	3	B1	3	PE4	I/O	FT	-	TRACED1, TIM3_CH2, DFSDM_DATIN3, TSC_G7_IO3, FMC_A20, SAI1_FS_A, EVENTOUT	-
-	-	4	C2	4	PE5	I/O	FT	-	TRACED2, TIM3_CH3, DFSDM_CKIN3, TSC_G7_IO4, FMC_A21, SAI1_SCK_A, EVENTOUT	-
-	-	5	D2	5	PE6	I/O	FT	-	TRACED3, TIM3_CH4, FMC_A22, SAI1_SD_A, EVENTOUT	RTC_TAMP3/ WKUP3
1	B9	6	E2	6	VBAT	S	-	-	-	-
2	B8	7	C1	7	PC13	I/O	FT	(1) (2)	EVENTOUT	RTC_TAMP1/ RTC_TS/ RTC_OUT/ WKUP2
3	C9	8	D1	8	PC14/ OSC32_IN	I/O	FT	(1) (2)	EVENTOUT	OSC32_IN
4	C8	9	E1	9	PC15/ OSC32_OUT	I/O	FT	(1) (2)	EVENTOUT	OSC32_OUT
-	-	-	D6	10	PF0	I/O	FT_f	-	I2C2_SDA, FMC_A0, EVENTOUT	-
-	-	-	D5	11	PF1	I/O	FT_f	-	I2C2_SCL, FMC_A1, EVENTOUT	-
-	-	-	D4	12	PF2	I/O	FT	-	I2C2_SMBA, FMC_A2, EVENTOUT	-
-	-	-	E4	13	PF3	I/O	FT_a	-	FMC_A3, EVENTOUT	ADC3_IN5
-	-	-	F3	14	PF4	I/O	FT_a	-	FMC_A4, EVENTOUT	ADC3_IN6
-	-	-	F4	15	PF5	I/O	FT_a	-	FMC_A5, EVENTOUT	ADC3_IN7
-	-	10	F2	16	VSS	S	-	-	-	-
-	-	11	G2	17	VDD	S	-	-	-	-
-	-	-	-	18	PF6	I/O	FT_a	-	TIM5_ETR, TIM5_CH1, SAI1_SD_B, EVENTOUT	ADC3_IN8
-	-	-	-	19	PF7	I/O	FT_a	-	TIM5_CH2, SAI1_MCK_B, EVENTOUT	ADC3_IN9
-	-	-	-	20	PF8	I/O	FT_a	-	TIM5_CH3, SAI1_SCK_B, EVENTOUT	ADC3_IN10
-	-	-	-	21	PF9	I/O	FT_a	-	TIM5_CH4, SAI1_FS_B, TIM15_CH1, EVENTOUT	ADC3_IN11

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	-	-	-	22	PF10	I/O	FT_a	-	TIM15_CH2, EVENTOUT	ADC3_IN12
5	D9	12	F1	23	PH0/OSC_IN	I/O	FT	-	EVENTOUT	OSC_IN
6	D8	13	G1	24	PH1/OSC_OUT	I/O	FT	-	EVENTOUT	OSC_OUT
7	E9	14	H2	25	NRST	RST	RST	-	-	-
8	F9	15	H1	26	PC0	I/O	FT_fla	-	LCDBIAS1, LPTIM1_IN1, I2C3_SCL, DFSDM_DATIN4, LPUART1_RX, LCD_SEG18, LPTIM2_IN1, EVENTOUT	ADC123_IN1
9	F8	16	J2	27	PC1	I/O	FT_fla	-	LCDBIAS2, LPTIM1_OUT, I2C3_SDA, DFSDM_CKIN4, LPUART1_TX, LCD_SEG19, EVENTOUT	ADC123_IN2
10	F7	17	J3	28	PC2	I/O	FT_la	-	LCDBIAS3, LPTIM1_IN2, SPI2_MISO, DFSDM_CKOUT, LCD_SEG20, EVENTOUT	ADC123_IN3
11	G7	18	K2	29	PC3	I/O	FT_a	-	LPTIM1_ETR, SPI2_MOSI, LCD_VLCD, SAI1_SD_A, LPTIM2_ETR, EVENTOUT	ADC123_IN4
12	G9	19	J1	30	VSSA	S	-	-	-	-
12	G9	20	J1	31	VREF-	S	-	-	-	-
13	G8	21	L1	32	VREF+	S	-	-	-	VREFBUF_OUT
13	H9	22	M1	33	VDDA	S	-	-	-	-
14	H8	23	L2	34	PA0	I/O	FT_a	-	TIM2_CH1, TIM5_CH1, TIM8_ETR, USART2_CTS, UART4_TX, SAI1_EXTCLK, TIM2_ETR, EVENTOUT	OPAMP1_VINP, ADC12_IN5, RTC_TAMP2/WKUP1
-	-	-	M3	-	OPAMP1_ VINM	-	TT	-	-	-
15	G4	24	M2	35	PA1	I/O	FT_la	-	TIM2_CH2, TIM5_CH2, USART2_RTS_DE, UART4_RX, LCD_SEG0, TIM15_CH1N, EVENTOUT	OPAMP1_VINM, ADC12_IN6
16	G6	25	K3	36	PA2	I/O	FT_la	-	TIM2_CH3, TIM5_CH3, USART2_TX, LCD_SEG1, SAI2_EXTCLK, TIM15_CH1, EVENTOUT	ADC12_IN7, WKUP4/LSCO

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
17	H7	26	L3	37	PA3	I/O	TT	-	TIM2_CH4, TIM5_CH4, USART2_RX, LCD_SEG2, TIM15_CH2, EVENTOUT	OPAMP1_VOUT, ADC12_IN8
18	J9	27	E3	38	VSS	S	-	-	-	-
19	J8	28	H3	39	VDD	S	-	-	-	-
20	G5	29	J4	40	PA4	I/O	TT_a	-	SPI1_NSS, SPI3_NSS, USART2_CK, SAI1_FS_B, LPTIM2_OUT, EVENTOUT	ADC12_IN9, DAC1_OUT1
21	H6	30	K4	41	PA5	I/O	TT_a	-	TIM2_CH1, TIM2_ETR, TIM8_CH1N, SPI1_SCK, LPTIM2_ETR, EVENTOUT	ADC12_IN10, DAC1_OUT2
22	H5	31	L4	42	PA6	I/O	FT_la	-	TIM1_BKIN, TIM3_CH1, TIM8_BKIN, SPI1_MISO, USART3_CTS, QUADSPI_BK1_IO3, LCD_SEG3, TIM1_BKIN_COMP2, TIM8_BKIN_COMP2, TIM16_CH1, EVENTOUT	OPAMP2_VINP, ADC12_IN11
-	-	-	M4	-	OPAMP2_ VINM	-	TT	-	-	-
23	H4	32	J5	43	PA7	I/O	FT_la	-	TIM1_CH1N, TIM3_CH2, TIM8_CH1N, SPI1_MOSI, QUADSPI_BK1_IO2, LCD_SEG4, TIM17_CH1, EVENTOUT	OPAMP2_VINM, ADC12_IN12
24	J7	33	K5	44	PC4	I/O	FT_la	-	USART3_TX, LCD_SEG22, EVENTOUT	COMP1_INM, ADC12_IN13
25	J6	34	L5	45	PC5	I/O	FT_la	-	USART3_RX, LCD_SEG23, EVENTOUT	COMP1_INP, ADC12_IN14, WKUP5
26	J5	35	M5	46	PB0	I/O	TT_la	-	TIM1_CH2N, TIM3_CH3, TIM8_CH2N, USART3_CK, QUADSPI_BK1_IO1, LCD_SEG5, COMP1_OUT, EVENTOUT	OPAMP2_VOUT, ADC12_IN15
27	J4	36	M6	47	PB1	I/O	FT_la	-	TIM1_CH3N, TIM3_CH4, TIM8_CH3N, DFSDM_DATIN0, USART3_RTS_DE, QUADSPI_BK1_IO0, LCD_SEG6, LPTIM2_IN1, EVENTOUT	COMP1_INM, ADC12_IN16

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
28	J3	37	L6	48	PB2	I/O	FT_a	-	RTC_OUT, LPTIM1_OUT, I2C3_SMBA, DFSDM_CKIN0, EVENTOUT	COMP1_INP
-	-	-	K6	49	PF11	I/O	FT	-	EVENTOUT	-
-	-	-	J7	50	PF12	I/O	FT	-	FMC_A6, EVENTOUT	-
-	-	-	-	51	VSS	S	-	-	-	-
-	-	-	-	52	VDD	S	-	-	-	-
-	-	-	K7	53	PF13	I/O	FT	-	DFSDM_DATIN6, FMC_A7, EVENTOUT	-
-	-	-	J8	54	PF14	I/O	FT	-	DFSDM_CKIN6, TSC_G8_IO1, FMC_A8, EVENTOUT	-
-	-	-	J9	55	PF15	I/O	FT	-	TSC_G8_IO2, FMC_A9, EVENTOUT	-
-	-	-	H9	56	PG0	I/O	FT	-	TSC_G8_IO3, FMC_A10, EVENTOUT	-
-	-	-	G9	57	PG1	I/O	FT	-	TSC_G8_IO4, FMC_A11, EVENTOUT	-
-	-	38	M7	58	PE7	I/O	FT	-	TIM1_ETR, DFSDM_DATIN2, FMC_D4, SAI1_SD_B, EVENTOUT	-
-	-	39	L7	59	PE8	I/O	FT	-	TIM1_CH1N, DFSDM_CKIN2, FMC_D5, SAI1_SCK_B, EVENTOUT	-
-	-	40	M8	60	PE9	I/O	FT	-	TIM1_CH1, DFSDM_CKOUT, FMC_D6, SAI1_FS_B, EVENTOUT	-
-	-	-	F6	61	VSS	S	-	-	-	-
-	-	-	G6	62	VDD	S	-	-	-	-
-	-	41	L8	63	PE10	I/O	FT	-	TIM1_CH2N, DFSDM_DATIN4, TSC_G5_IO1, QUADSPI_CLK, FMC_D7, SAI1_MCK_B, EVENTOUT	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	-	42	M9	64	PE11	I/O	FT	-	TIM1_CH2, DFSDM_CKIN4, TSC_G5_IO2, QUADSPI_NCS, FMC_D8, EVENTOUT	-
-	-	43	L9	65	PE12	I/O	FT	-	TIM1_CH3N, SPI1_NSS, DFSDM_DATIN5, TSC_G5_IO3, QUADSPI_BK1_IO0, FMC_D9, EVENTOUT	-
-	-	44	M10	66	PE13	I/O	FT	-	TIM1_CH3, SPI1_SCK, DFSDM_CKIN5, TSC_G5_IO4, QUADSPI_BK1_IO1, FMC_D10, EVENTOUT	-
-	-	45	M11	67	PE14	I/O	FT	-	TIM1_CH4, TIM1_BKIN2, TIM1_BKIN2_COMP2, SPI1_MISO, QUADSPI_BK1_IO2, FMC_D11, EVENTOUT	-
-	-	46	M12	68	PE15	I/O	FT	-	TIM1_BKIN, TIM1_BKIN_COMP1, SPI1_MOSI, QUADSPI_BK1_IO3, FMC_D12, EVENTOUT	-
29	H3	47	L10	69	PB10	I/O	FT_fl	-	TIM2_CH3, I2C2_SCL, SPI2_SCK, DFSDM_DATIN7, USART3_TX, LPUART1_RX, QUADSPI_CLK, LCD_SEG10, COMP1_OUT, SAI1_SCK_A, EVENTOUT	-
30	G3	48	L11	70	PB11	I/O	FT_fl	-	TIM2_CH4, I2C2_SDA, DFSDM_CKIN7, USART3_RX, LPUART1_TX, QUADSPI_NCS, LCD_SEG11, COMP2_OUT, EVENTOUT	-
31	J2	49	F12	71	VSS	S	-	-	-	-
32	J1	50	G12	72	VDD	S	-	-	-	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
33	H1	51	L12	73	PB12	I/O	FT_l	-	TIM1_BKIN, TIM1_BKIN_COMP2, I2C2_SMBA, SPI2_NSS, DFSDM_DATIN1, USART3_CK, LPUART1_RTS_DE, TSC_G1_IO1, LCD_SEG12, SWPMI1_IO, SAI2_FS_A, TIM15_BKIN, EVENTOUT	-
34	H2	52	K12	74	PB13	I/O	FT_fl	-	TIM1_CH1N, I2C2_SCL, SPI2_SCK, DFSDM_CKIN1, USART3_CTS, LPUART1_CTS, TSC_G1_IO2, LCD_SEG13, SWPMI1_TX, SAI2_SCK_A, TIM15_CH1N, EVENTOUT	-
35	G2	53	K11	75	PB14	I/O	FT_fl	-	TIM1_CH2N, TIM8_CH2N, I2C2_SDA, SPI2_MISO, DFSDM_DATIN2, USART3_RTS_DE, TSC_G1_IO3, LCD_SEG14, SWPMI1_RX, SAI2_MCK_A, TIM15_CH1, EVENTOUT	-
36	G1	54	K10	76	PB15	I/O	FT_l	-	RTC_REFIN, TIM1_CH3N, TIM8_CH3N, SPI2_MOSI, DFSDM_CKIN2, TSC_G1_IO4, LCD_SEG15, SWPMI1_SUSPEND, SAI2_SD_A, TIM15_CH2, EVENTOUT	-
-	-	55	K9	77	PD8	I/O	FT_l	-	USART3_TX, LCD_SEG28, FMC_D13, EVENTOUT	-
-	-	56	K8	78	PD9	I/O	FT_l	-	USART3_RX, LCD_SEG29, FMC_D14, SAI2_MCK_A, EVENTOUT	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	-	57	J12	79	PD10	I/O	FT_l	-	USART3_CK, TSC_G6_IO1, LCD_SEG30, FMC_D15, SAI2_SCK_A, EVENTOUT	-
-	-	58	J11	80	PD11	I/O	FT_l	-	USART3_CTS, TSC_G6_IO2, LCD_SEG31, FMC_A16, SAI2_SD_A, LPTIM2_ETR, EVENTOUT	-
-	-	59	J10	81	PD12	I/O	FT_l	-	TIM4_CH1, USART3_RTS_DE, TSC_G6_IO3, LCD_SEG32, FMC_A17, SAI2_FS_A, LPTIM2_IN1, EVENTOUT	-
-	-	60	H12	82	PD13	I/O	FT_l	-	TIM4_CH2, TSC_G6_IO4, LCD_SEG33, FMC_A18, LPTIM2_OUT, EVENTOUT	-
-	-	-	-	83	VSS	S	-	-	-	-
-	-	-	-	84	VDD	S	-	-	-	-
-	-	61	H11	85	PD14	I/O	FT_l	-	TIM4_CH3, LCD_SEG34, FMC_D0, EVENTOUT	-
-	-	62	H10	86	PD15	I/O	FT_l	-	TIM4_CH4, LCD_SEG35, FMC_D1, EVENTOUT	-
-	-	-	G10	87	PG2	I/O	FT_s	-	SPI1_SCK, FMC_A12, SAI2_SCK_B, EVENTOUT	-
-	-	-	F9	88	PG3	I/O	FT_s	-	SPI1_MISO, FMC_A13, SAI2_FS_B, EVENTOUT	-
-	-	-	F10	89	PG4	I/O	FT_s	-	SPI1_MOSI, FMC_A14, SAI2_MCK_B, EVENTOUT	-
-	-	-	E9	90	PG5	I/O	FT_s	-	SPI1_NSS, LPUART1_CTS, FMC_A15, SAI2_SD_B, EVENTOUT	-
-	-	-	G4	91	PG6	I/O	FT_s	-	I2C3_SMBA, LPUART1_RTS_DE, EVENTOUT	-
-	-	-	H4	92	PG7	I/O	FT_fs	-	I2C3_SCL, LPUART1_TX, FMC_INT3, EVENTOUT	-
-	-	-	J6	93	PG8	I/O	FT_fs	-	I2C3_SDA, LPUART1_RX, EVENTOUT	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	-	-	-	94	VSS	S	-	-	-	-
-	-	-	-	95	VDDIO2	S	-	-	-	-
37	F3	63	E12	96	PC6	I/O	FT_l	-	TIM3_CH1, TIM8_CH1, DFSDM_CKIN3, TSC_G4_IO1, LCD_SEG24, SDMMC_D6, SAI2_MCK_A, EVENTOUT	-
38	F1	64	E11	97	PC7	I/O	FT_l	-	TIM3_CH2, TIM8_CH2, DFSDM_DATIN3, TSC_G4_IO2, LCD_SEG25, SDMMC_D7, SAI2_MCK_B, EVENTOUT	-
39	F2	65	E10	98	PC8	I/O	FT_l	-	TIM3_CH3, TIM8_CH3, TSC_G4_IO3, LCD_SEG26, SDMMC_D0, EVENTOUT	-
40	E1	66	D12	99	PC9	I/O	FT_l	-	TIM8_BKIN2, TIM3_CH4, TIM8_CH4, TSC_G4_IO4, OTG_FS_NOE, LCD_SEG27, SDMMC_D1, SAI2_EXTCLK, TIM8_BKIN2_COMP1, EVENTOUT	-
41	E2	67	D11	100	PA8	I/O	FT_l	-	MCO, TIM1_CH1, USART1_CK, OTG_FS_SOF, LCD_COM0, LPTIM2_OUT, EVENTOUT	-
42	E3	68	D10	101	PA9	I/O	FT_lu	-	TIM1_CH2, USART1_TX, OTG_FS_VBUS, LCD_COM1, TIM15_BKIN, EVENTOUT	-
43	D2	69	C12	102	PA10	I/O	FT_lu	-	TIM1_CH3, USART1_RX, OTG_FS_ID, LCD_COM2, TIM17_BKIN, EVENTOUT	-
44	D1	70	B12	103	PA11	I/O	FT_u	-	TIM1_CH4, TIM1_BKIN2, USART1_CTS, CAN1_RX, OTG_FS_DM, TIM1_BKIN2_COMP1, EVENTOUT	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
45	C1	71	A12	104	PA12	I/O	FT_u	-	TIM1_ETR, USART1_RTS_DE, CAN1_TX, OTG_FS_DP, EVENTOUT	-
46	C2	72	A11	105	PA13	I/O	FT	(3)	JTMS/SWDAT, IR_OUT, OTG_FS_NOE, EVENTOUT	-
47	B1	-	-	-	VSS	S	-	-	-	-
48	A1	73	C11	106	VDDUSB	S	-	-	-	-
-	-	74	F11	107	VSS	S	-	-	-	-
-	-	75	G11	108	VDD	S	-	-	-	-
49	B2	76	A10	109	PA14	I/O	FT	(3)	JTCK/SWCLK, EVENTOUT	-
50	A2	77	A9	110	PA15	I/O	FT_l	(3)	JTDI, TIM2_CH1, TIM2_ETR, SPI1_NSS, SPI3_NSS, UART4_RTS_DE, TSC_G3_IO1, LCD_SEG17, SAI2_FS_B, EVENTOUT	-
51	D3	78	B11	111	PC10	I/O	FT_l	-	SPI3_SCK, USART3_TX, UART4_TX, TSC_G3_IO2, LCD_COM4/LCD_SEG28/ LCD_SEG40, SDMMC_D2, SAI2_SCK_B, EVENTOUT	-
52	C3	79	C10	112	PC11	I/O	FT_l	-	SPI3_MISO, USART3_RX, UART4_RX, TSC_G3_IO3, LCD_COM5/LCD_SEG29/ LCD_SEG41, SDMMC_D3, SAI2_MCK_B, EVENTOUT	-
53	B3	80	B10	113	PC12	I/O	FT_l	-	SPI3_MOSI, USART3_CK, UART5_TX, TSC_G3_IO4, LCD_COM6/LCD_SEG30/ LCD_SEG42, SDMMC_CK, SAI2_SD_B, EVENTOUT	-
-	-	81	C9	114	PD0	I/O	FT	-	SPI2_NSS, DFSDM_DATIN7, CAN1_RX, FMC_D2, EVENTOUT	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	-	82	B9	115	PD1	I/O	FT	-	SPI2_SCK, DFSDM_CKIN7, CAN1_TX, FMC_D3, EVENTOUT	-
54	A3	83	C8	116	PD2	I/O	FT_l	-	TIM3_ETR, USART3_RTS_DE, UART5_RX, LCD_COM7/LCD_SEG31/ LCD_SEG43, SDMMC_CMD, EVENTOUT	-
-	-	84	B8	117	PD3	I/O	FT	-	SPI2_MISO, DFSDM_DATIN0, USART2_CTS, FMC_CLK, EVENTOUT	-
-	-	85	B7	118	PD4	I/O	FT	-	SPI2_MOSI, DFSDM_CKIN0, USART2_RTS_DE, FMC_NOE, EVENTOUT	-
-	-	86	A6	119	PD5	I/O	FT	-	USART2_TX, FMC_NWE, EVENTOUT	-
-	-	-	-	120	VSS	S	-	-	-	-
-	-	-	-	121	VDD	S	-	-	-	-
-	-	87	B6	122	PD6	I/O	FT	-	DFSDM_DATIN1, USART2_RX, FMC_NWAIT, SAI1_SD_A, EVENTOUT	-
-	-	88	A5	123	PD7	I/O	FT	-	DFSDM_CKIN1, USART2_CK, FMC_NE1, EVENTOUT	-
-	A4	-	D9	124	PG9	I/O	FT_s	-	SPI3_SCK, USART1_TX, FMC_NCE3/FMC_NE2, SAI2_SCK_A, TIM15_CH1N, EVENTOUT	-
-	B4	-	D8	125	PG10	I/O	FT_s	-	LPTIM1_IN1, SPI3_MISO, USART1_RX, FMC_NE3, SAI2_FS_A, TIM15_CH1, EVENTOUT	-
-	C4	-	G3	126	PG11	I/O	FT_s	-	LPTIM1_IN2, SPI3_MOSI, USART1_CTS, SAI2_MCK_A, TIM15_CH2, EVENTOUT	-

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
-	C5	-	D7	127	PG12	I/O	FT_s	-	LPTIM1_ETR, SPI3_NSS, USART1_RTS_DE, FMC_NE4, SAI2_SD_A, EVENTOUT	-
-	B5	-	C7	128	PG13	I/O	FT_fs	-	I2C1_SDA, USART1_CK, FMC_A24, EVENTOUT	-
-	A5	-	C6	129	PG14	I/O	FT_fs	-	I2C1_SCL, FMC_A25, EVENTOUT	-
-	-	-	F7	130	VSS	S	-	-	-	-
-	B6	-	G7	131	VDDIO2	S	-	-	-	-
-	-	-	K1	132	PG15	I/O	FT_s	-	LPTIM1_OUT, I2C1_SMBA, EVENTOUT	-
55	A6	89	A8	133	PB3	I/O	FT_la	(3)	JTDO/TRACESWO, TIM2_CH2, SPI1_SCK, SPI3_SCK, USART1_RTS_DE, LCD_SEG7, SAI1_SCK_B, EVENTOUT	COMP2_INM
56	C6	90	A7	134	PB4	I/O	FT_la	(3)	NJTRST, TIM3_CH1, SPI1_MISO, SPI3_MISO, USART1_CTS, UART5_RTS_DE, TSC_G2_IO1, LCD_SEG8, SAI1_MCK_B, TIM17_BKIN, EVENTOUT	COMP2_INP
57	C7	91	C5	135	PB5	I/O	FT_la	-	LPTIM1_IN1, TIM3_CH2, I2C1_SMBA, SPI1_MOSI, SPI3_MOSI, USART1_CK, UART5_CTS, TSC_G2_IO2, LCD_SEG9, COMP2_OUT, SAI1_SD_B, TIM16_BKIN, EVENTOUT	-
58	B7	92	B5	136	PB6	I/O	FT_fa	-	LPTIM1_ETR, TIM4_CH1, TIM8_BKIN2, I2C1_SCL, DFSDM_DATIN5, USART1_TX, TSC_G2_IO3, TIM8_BKIN2_COMP2, SAI1_FS_B, TIM16_CH1N, EVENTOUT	COMP2_INP

Table 14. STM32L476xx pin definitions (continued)

Pin Number					Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	CSP72	LQFP100	BGA132	LQFP144					Alternate functions	Additional functions
59	A7	93	B4	137	PB7	I/O	FT_fla	-	LPTIM1_IN2, TIM4_CH2, TIM8_BKIN, I2C1_SDA, DFSDM_CKIN5, USART1_RX, UART4_CTS, TSC_G2_IO4, LCD_SEG21, FMC_NL, TIM8_BKIN_COMP1, TIM17_CH1N, EVENTOUT	COMP2_INM, PVD_IN
60	D7	94	A4	138	BOOT0	I	-	-	-	-
61	E7	95	A3	139	PB8	I/O	FT_fl	-	TIM4_CH3, I2C1_SCL, DFSDM_DATIN6, CAN1_RX, LCD_SEG16, SDMMC_D4, SAI1_MCK_A, TIM16_CH1, EVENTOUT	-
62	E8	96	B3	140	PB9	I/O	FT_fl	-	IR_OUT, TIM4_CH4, I2C1_SDA, SPI2_NSS, DFSDM_CKIN6, CAN1_TX, LCD_COM3, SDMMC_D5, SAI1_FS_A, TIM17_CH1, EVENTOUT	-
-	-	97	C3	141	PE0	I/O	FT_l	-	TIM4_ETR, LCD_SEG36, FMC_NBL0, TIM16_CH1, EVENTOUT	-
-	-	98	A2	142	PE1	I/O	FT_l	-	LCD_SEG37, FMC_NBL1, TIM17_CH1, EVENTOUT	-
63	A8	99	D3	143	VSS	S	-	-	-	-
64	A9	100	C4	144	VDD	S	-	-	-	-

1. PC13, PC14 and PC15 are supplied through the power switch. Since the switch only sinks a limited amount of current (3 mA), the use of GPIOs PC13 to PC15 in output mode is limited:
   - The speed should not exceed 2 MHz with a maximum load of 30 pF
   - These GPIOs must not be used as current sources (e.g. to drive an LED).
2. After a Backup domain power-up, PC13, PC14 and PC15 operate as GPIOs. Their function then dependson the content of the RTC registers which are not reset by the system reset. For details on how to manage these GPIOs, refer to the Backup domain and RTC register descriptions in the reference manual.
3. After reset, these pins are configured as JTAG/SW debug alternate functions, and the internal pull-up on PA15, PA13, PB4 pins and the internal pull-down on PA14 pin are activated.

Table 15. Alternate function AF0 to AF7 (for AF8 to AF15 see *Table 16*)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7
		SYS_AF	**TIM1/TIM2/TIM5/TIM8/LPTIM1**	**TIM1/TIM2/TIM3/TIM4/TIM5**	**TIM8**	**I2C1/I2C2/I2C3**	**SPI1/SPI2**	**SPI3/DFSDM**	**USART1/USART2/USART3**
Port A	PA0	-	TIM2_CH1	TIM5_CH1	TIM8_ETR	-	-	-	USART2_CTS
	PA1	-	TIM2_CH2	TIM5_CH2	-	-	-	-	USART2_RTS_DE
	PA2	-	TIM2_CH3	TIM5_CH3	-	-	-	-	USART2_TX
	PA3	-	TIM2_CH4	TIM5_CH4	-	-	-	-	USART2_RX
	PA4	-	-	-	-	-	SPI1_NSS	SPI3_NSS	USART2_CK
	PA5	-	TIM2_CH1	TIM2_ETR	TIM8_CH1N	-	SPI1_SCK	-	-
	PA6	-	TIM1_BKIN	TIM3_CH1	TIM8_BKIN	-	SPI1_MISO	-	USART3_CTS
	PA7	-	TIM1_CH1N	TIM3_CH2	TIM8_CH1N	-	SPI1_MOSI	-	-
	PA8	MCO	TIM1_CH1	-	-	-	-	-	USART1_CK
	PA9	-	TIM1_CH2	-	-	-	-	-	USART1_TX
	PA10	-	TIM1_CH3	-	-	-	-	-	USART1_RX
	PA11	-	TIM1_CH4	TIM1_BKIN2	-	-	-	-	USART1_CTS
	PA12	-	TIM1_ETR	-	-	-	-	-	USART1_RTS_DE
	PA13	JTMS/SWDAT	IR_OUT	-	-	-	-	-	-
	PA14	JTCK/SWCLK	-	-	-	-	-	-	-
	PA15	JTDI	TIM2_CH1	TIM2_ETR	-	-	SPI1_NSS	SPI3_NSS	-

Table 15. Alternate function AF0 to AF7 (for AF8 to AF15 see *Table 16*) (continued)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7
		SYS_AF	**TIM1/TIM2/TIM5/TIM8/LPTIM1**	**TIM1/TIM2/TIM3/TIM4/TIM5**	**TIM8**	**I2C1/I2C2/I2C3**	**SPI1/SPI2**	**SPI3/DFSDM**	**USART1/USART2/USART3**
Port B	PB0	-	TIM1_CH2N	TIM3_CH3	TIM8_CH2N	-	-	-	USART3_CK
	PB1	-	TIM1_CH3N	TIM3_CH4	TIM8_CH3N	-	-	DFSDM_DATIN0	USART3_RTS_DE
	PB2	RTC_OUT	LPTIM1_OUT	-	-	I2C3_SMBA	-	DFSDM_CKIN0	-
	PB3	JTDO/TRACESWO	TIM2_CH2	-	-	-	SPI1_SCK	SPI3_SCK	USART1_RTS_DE
	PB4	NJTRST	-	TIM3_CH1	-	-	SPI1_MISO	SPI3_MISO	USART1_CTS
	PB5	-	LPTIM1_IN1	TIM3_CH2	-	I2C1_SMBA	SPI1_MOSI	SPI3_MOSI	USART1_CK
	PB6	-	LPTIM1_ETR	TIM4_CH1	TIM8_BKIN2	I2C1_SCL	-	DFSDM_DATIN5	USART1_TX
	PB7	-	LPTIM1_IN2	TIM4_CH2	TIM8_BKIN	I2C1_SDA	-	DFSDM_CKIN5	USART1_RX
	PB8	-		TIM4_CH3	-	I2C1_SCL	-	DFSDM_DATIN6	-
	PB9	-	IR_OUT	TIM4_CH4	-	I2C1_SDA	SPI2_NSS	DFSDM_CKIN6	-
	PB10	-	TIM2_CH3	-	-	I2C2_SCL	SPI2_SCK	DFSDM_DATIN7	USART3_TX
	PB11	-	TIM2_CH4	-	-	I2C2_SDA	-	DFSDM_CKIN7	USART3_RX
	PB12	-	TIM1_BKIN	-	TIM1_BKIN_COMP2	I2C2_SMBA	SPI2_NSS	DFSDM_DATIN1	USART3_CK
	PB13	-	TIM1_CH1N	-	-	I2C2_SCL	SPI2_SCK	DFSDM_CKIN1	USART3_CTS
	PB14	-	TIM1_CH2N	-	TIM8_CH2N	I2C2_SDA	SPI2_MISO	DFSDM_DATIN2	USART3_RTS_DE
	PB15	RTC_REFIN	TIM1_CH3N	-	TIM8_CH3N	-	SPI2_MOSI	DFSDM_CKIN2	-

Table 15. Alternate function AF0 to AF7 (for AF8 to AF15 see *Table 16*) (continued)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7
		SYS_AF	**TIM1/TIM2/TIM5/TIM8/LPTIM1**	**TIM1/TIM2/TIM3/TIM4/TIM5**	**TIM8**	**I2C1/I2C2/I2C3**	**SPI1/SPI2**	**SPI3/DFSDM**	**USART1/USART2/USART3**
Port C	PC0	LCDBIAS1	LPTIM1_IN1	-	-	I2C3_SCL	-	DFSDM_DATIN4	-
	PC1	LCDBIAS2	LPTIM1_OUT	-	-	I2C3_SDA	-	DFSDM_CKIN4	-
	PC2	LCDBIAS3	LPTIM1_IN2	-	-	-	SPI2_MISO	DFSDM_CKOUT	-
	PC3	-	LPTIM1_ETR	-	-	-	SPI2_MOSI	-	-
	PC4	-	-	-	-	-	-	-	USART3_TX
	PC5	-	-	-	-	-	-	-	USART3_RX
	PC6	-	-	TIM3_CH1	TIM8_CH1	-	-	DFSDM_CKIN3	-
	PC7	-	-	TIM3_CH2	TIM8_CH2	-	-	DFSDM_DATIN3	-
	PC8	-	-	TIM3_CH3	TIM8_CH3	-	-	-	-
	PC9	-	TIM8_BKIN2	TIM3_CH4	TIM8_CH4	-	-	-	-
	PC10	-	-	-	-	-	-	SPI3_SCK	USART3_TX
	PC11	-	-	-	-	-	-	SPI3_MISO	USART3_RX
	PC12	-	-	-	-	-	-	SPI3_MOSI	USART3_CK
	PC13	-	-	-	-	-	-	-	-
	PC14	-	-	-	-	-	-	-	-
	PC15	-	-	-	-	-	-	-	-

Table 15. Alternate function AF0 to AF7 (for AF8 to AF15 see *Table 16*) (continued)

Port		**AF0**	**AF1**	**AF2**	**AF3**	**AF4**	**AF5**	**AF6**	**AF7**
		SYS_AF	**TIM1/TIM2/TIM5/TIM8/LPTIM1**	**TIM1/TIM2/TIM3/TIM4/TIM5**	**TIM8**	**I2C1/I2C2/I2C3**	**SPI1/SPI2**	**SPI3/DFSDM**	**USART1/USART2/USART3**
Port D	PD0	-	-	-	-	-	SPI2_NSS	DFSDM_DATIN7	-
	PD1	-	-	-	-	-	SPI2_SCK	DFSDM_CKIN7	-
	PD2	-	-	TIM3_ETR	-	-	-	-	USART3_RTS_DE
	PD3	-	-	-	-	-	SPI2_MISO	DFSDM_DATIN0	USART2_CTS
	PD4	-	-	-	-	-	SPI2_MOSI	DFSDM_CKIN0	USART2_RTS_DE
	PD5	-	-	-	-	-	-		USART2_TX
	PD6	-	-	-	-	-	-	DFSDM_DATIN1	USART2_RX
	PD7	-	-	-	-	-	-	DFSDM_CKIN1	USART2_CK
	PD8	-	-	-	-	-	-	-	USART3_TX
	PD9	-	-	-	-	-	-	-	USART3_RX
	PD10	-	-	-	-	-	-	-	USART3_CK
	PD11	-	-	-	-	-	-	-	USART3_CTS
	PD12	-	-	TIM4_CH1	-	-	-	-	USART3_RTS_DE
	PD13	-	-	TIM4_CH2	-	-	-	-	-
	PD14	-	-	TIM4_CH3	-	-	-	-	-
	PD15	-	-	TIM4_CH4	-	-	-	-	-

Table 15. Alternate function AF0 to AF7 (for AF8 to AF15 see *Table 16*) (continued)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7
		SYS_AF	TIM1/TIM2/TIM5/TIM8/LPTIM1	TIM1/TIM2/TIM3/TIM4/TIM5	TIM8	I2C1/I2C2/I2C3	SPI1/SPI2	SPI3/DFSDM	USART1/USART2/USART3
Port E	PE0	-	-	TIM4_ETR	-	-	-	-	-
	PE1	-	-	-	-	-	-	-	-
	PE2	TRACECK	-	TIM3_ETR	-	-	-	-	-
	PE3	TRACED0	-	TIM3_CH1	-	-	-	-	-
	PE4	TRACED1	-	TIM3_CH2	-	-	-	DFSDM_DATIN3	-
	PE5	TRACED2	-	TIM3_CH3	-	-	-	DFSDM_CKIN3	-
	PE6	TRACED3	-	TIM3_CH4	-	-	-		-
	PE7	-	TIM1_ETR	-	-	-	-	DFSDM_DATIN2	-
	PE8	-	TIM1_CH1N	-	-	-	-	DFSDM_CKIN2	-
	PE9	-	TIM1_CH1	-	-	-	-	DFSDM_CKOUT	-
	PE10	-	TIM1_CH2N	-	-	-	-	DFSDM_DATIN4	-
	PE11	-	TIM1_CH2	-	-	-	-	DFSDM_CKIN4	-
	PE12	-	TIM1_CH3N	-	-	-	SPI1_NSS	DFSDM_DATIN5	-
	PE13	-	TIM1_CH3	-	-	-	SPI1_SCK	DFSDM_CKIN5	-
	PE14	-	TIM1_CH4	TIM1_BKIN2	TIM1_BKIN2_COMP2	-	SPI1_MISO	-	-
	PE15	-	TIM1_BKIN	-	TIM1_BKIN_COMP1	-	SPI1_MOSI	-	-

Table 15. Alternate function AF0 to AF7 (for AF8 to AF15 see Table 16) (continued)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7
		SYS_AF	**TIM1/TIM2/TIM5/TIM8/LPTIM1**	**TIM1/TIM2/TIM3/TIM4/TIM5**	**TIM8**	**I2C1/I2C2/I2C3**	**SPI1/SPI2**	**SPI3/DFSDM**	**USART1/USART2/USART3**
Port F	PF0	-	-	-	-	I2C2_SDA	-	-	-
	PF1	-	-	-	-	I2C2_SCL	-	-	-
	PF2	-	-	-	-	I2C2_SMBA	-	-	-
	PF3	-	-	-	-	-	-	-	-
	PF4	-	-	-	-	-	-	-	-
	PF5	-	-	-	-	-	-	-	-
	PF6	-	TIM5_ETR	TIM5_CH1	-	-	-	-	-
	PF7	-	-	TIM5_CH2	-	-	-	-	-
	PF8	-	-	TIM5_CH3	-	-	-	-	-
	PF9	-	-	TIM5_CH4	-	-	-	-	-
	PF10	-	-	-	-	-	-	-	-
	PF11	-	-	-	-	-	-	-	-
	PF12	-	-	-	-	-	-	-	-
	PF13	-	-	-	-	-	-	DFSDM_DATIN6	-
	PF14	-	-	-	-	-	-	DFSDM_CKIN6	-
	PF15	-	-	-	-	-	-	-	-

Table 15. Alternate function AF0 to AF7 (for AF8 to AF15 see *Table 16*) (continued)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7
		SYS_AF	TIM1/TIM2/TIM5/TIM8/LPTIM1	TIM1/TIM2/TIM3/TIM4/TIM5	TIM8	I2C1/I2C2/I2C3	SPI1/SPI2	SPI3/DFSDM	USART1/USART2/USART3
Port G	PG0	-	-	-	-	-	-	-	-
	PG1	-	-	-	-	-	-	-	-
	PG2	-	-	-	-	-	SPI1_SCK	-	-
	PG3	-	-	-	-	-	SPI1_MISO	-	-
	PG4	-	-	-	-	-	SPI1_MOSI	-	-
	PG5	-	-	-	-	-	SPI1_NSS	-	-
	PG6	-	-	-	-	I2C3_SMBA	-	-	-
	PG7	-	-	-	-	I2C3_SCL	-	-	-
	PG8	-	-	-	-	I2C3_SDA	-	-	-
	PG9	-	-	-	-	-	-	SPI3_SCK	USART1_TX
	PG10	-	LPTIM1_IN1	-	-	-	-	SPI3_MISO	USART1_RX
	PG11	-	LPTIM1_IN2	-	-	-	-	SPI3_MOSI	USART1_CTS
	PG12	-	LPTIM1_ETR	-	-	-	-	SPI3_NSS	USART1_RTS_DE
	PG13	-	-	-	-	I2C1_SDA	-	-	USART1_CK
	PG14	-	-	-	-	I2C1_SCL	-	-	-
	PG15	-	LPTIM1_OUT	-	-	I2C1_SMBA	-	-	-
Port H	PH0	-	-	-	-	-	-	-	-
	PH1	-	-	-	-	-	-	-	-

Table 16. Alternate function AF8 to AF15 (for AF0 to AF7 see *Table 15*)

Port		AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		UART4, UART5, LPUART1	**CAN1, TSC**	**OTG_FS, QUADSPI**	**LCD**	**SDMMC, COMP1, COMP2, FMC, SWPMI1**	**SAI1, SAI2**	**TIM2, TIM15, TIM16, TIM17, LPTIM2**	**EVENTOUT**
Port A	PA0	UART4_TX	-	-	-	-	SAI1_EXTCLK	TIM2_ETR	EVENTOUT
	PA1	UART4_RX	-	-	LCD_SEG0	-		TIM15_CH1N	EVENTOUT
	PA2	-	-	-	LCD_SEG1	-	SAI2_EXTCLK	TIM15_CH1	EVENTOUT
	PA3	-	-	-	LCD_SEG2	-	-	TIM15_CH2	EVENTOUT
	PA4	-	-	-	-	-	SAI1_FS_B	LPTIM2_OUT	EVENTOUT
	PA5	-	-	-	-	-	-	LPTIM2_ETR	EVENTOUT
	PA6	-	-	QUADSPI_BK1_IO3	LCD_SEG3	TIM1_BKIN_COMP2	TIM8_BKIN_COMP2	TIM16_CH1	EVENTOUT
	PA7	-	-	QUADSPI_BK1_IO2	LCD_SEG4	-	-	TIM17_CH1	EVENTOUT
	PA8	-	-	OTG_FS_SOF	LCD_COM0	-	-	LPTIM2_OUT	EVENTOUT
	PA9	-	-	OTG_FS_VBUS	LCD_COM1	-	-	TIM15_BKIN	EVENTOUT
	PA10	-	-	OTG_FS_ID	LCD_COM2	-	-	TIM17_BKIN	EVENTOUT
	PA11	-	CAN1_RX	OTG_FS_DM	-	TIM1_BKIN2_COMP1	-	-	EVENTOUT
	PA12	-	CAN1_TX	OTG_FS_DP	-	-	-	-	EVENTOUT
	PA13	-	-	OTG_FS_NOE	-	-	-	-	EVENTOUT
	PA14	-	-	-	-	-	-	-	EVENTOUT
	PA15	UART4_RTS_DE	TSC_G3_IO1	-	LCD_SEG17	-	SAI2_FS_B	-	EVENTOUT

Table 16. Alternate function AF8 to AF15 (for AF0 to AF7 see *Table 15*) (continued)

Port		AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		UART4, UART5, LPUART1	**CAN1, TSC**	**OTG_FS, QUADSPI**	**LCD**	**SDMMC, COMP1, COMP2, FMC, SWPMI1**	**SAI1, SAI2**	**TIM2, TIM15, TIM16, TIM17, LPTIM2**	**EVENTOUT**
Port B	PB0	-	-	QUADSPI_BK1_IO1	LCD_SEG5	COMP1_OUT	-	-	EVENTOUT
	PB1	-	-	QUADSPI_BK1_IO0	LCD_SEG6	-	-	LPTIM2_IN1	EVENTOUT
	PB2	-	-	-	-	-	-	-	EVENTOUT
	PB3	-	-	-	LCD_SEG7	-	SAI1_SCK_B	-	EVENTOUT
	PB4	UART5_RTS_DE	TSC_G2_IO1	-	LCD_SEG8	-	SAI1_MCK_B	TIM17_BKIN	EVENTOUT
	PB5	UART5_CTS	TSC_G2_IO2	-	LCD_SEG9	COMP2_OUT	SAI1_SD_B	TIM16_BKIN	EVENTOUT
	PB6	-	TSC_G2_IO3	-	-	TIM8_BKIN2_COMP2	SAI1_FS_B	TIM16_CH1N	EVENTOUT
	PB7	UART4_CTS	TSC_G2_IO4	-	LCD_SEG21	FMC_NL	TIM8_BKIN_COMP1	TIM17_CH1N	EVENTOUT
	PB8	-	CAN1_RX	-	LCD_SEG16	SDMMC_D4	SAI1_MCK_A	TIM16_CH1	EVENTOUT
	PB9	-	CAN1_TX	-	LCD_COM3	SDMMC_D5	SAI1_FS_A	TIM17_CH1	EVENTOUT
	PB10	LPUART1_RX	-	QUADSPI_CLK	LCD_SEG10	COMP1_OUT	SAI1_SCK_A	-	EVENTOUT
	PB11	LPUART1_TX	-	QUADSPI_NCS	LCD_SEG11	COMP2_OUT	-	-	EVENTOUT
	PB12	LPUART1_RTS_DE	TSC_G1_IO1	-	LCD_SEG12	SWPMI1_IO	SAI2_FS_A	TIM15_BKIN	EVENTOUT
	PB13	LPUART1_CTS	TSC_G1_IO2	-	LCD_SEG13	SWPMI1_TX	SAI2_SCK_A	TIM15_CH1N	EVENTOUT
	PB14	-	TSC_G1_IO3	-	LCD_SEG14	SWPMI1_RX	SAI2_MCK_A	TIM15_CH1	EVENTOUT
	PB15	-	TSC_G1_IO4	-	LCD_SEG15	SWPMI1_SUSPEND	SAI2_SD_A	TIM15_CH2	EVENTOUT

Table 16. Alternate function AF8 to AF15 (for AF0 to AF7 see *Table 15*) (continued)

Port		AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		UART4, UART5, LPUART1	**CAN1, TSC**	**OTG_FS, QUADSPI**	**LCD**	**SDMMC, COMP1, COMP2, FMC, SWPMI1**	**SAI1, SAI2**	**TIM2, TIM15, TIM16, TIM17, LPTIM2**	**EVENTOUT**
Port C	PC0	LPUART1_RX	-	-	LCD_SEG18	-	-	LPTIM2_IN1	EVENTOUT
	PC1	LPUART1_TX	-	-	LCD_SEG19	-	-	-	EVENTOUT
	PC2	-	-	-	LCD_SEG20	-	-	-	EVENTOUT
	PC3	-	-	-	LCD_VLCD	-	SAI1_SD_A	LPTIM2_ETR	EVENTOUT
	PC4	-	-	-	LCD_SEG22	-	-	-	EVENTOUT
	PC5	-	-	-	LCD_SEG23	-	-	-	EVENTOUT
	PC6	-	TSC_G4_IO1	-	LCD_SEG24	SDMMC_D6	SAI2_MCK_A	-	EVENTOUT
	PC7	-	TSC_G4_IO2	-	LCD_SEG25	SDMMC_D7	SAI2_MCK_B	-	EVENTOUT
	PC8	-	TSC_G4_IO3	-	LCD_SEG26	SDMMC_D0	-	-	EVENTOUT
	PC9	-	TSC_G4_IO4	OTG_FS_NOE	LCD_SEG27	SDMMC_D1	SAI2_EXTCLK	TIM8_BKIN2_COMP1	EVENTOUT
	PC10	UART4_TX	TSC_G3_IO2	-	LCD_COM4/LCD_SEG28/LCD_SEG40	SDMMC_D2	SAI2_SCK_B	-	EVENTOUT
	PC11	UART4_RX	TSC_G3_IO3	-	LCD_COM5/LCD_SEG29/LCD_SEG41	SDMMC_D3	SAI2_MCK_B	-	EVENTOUT
	PC12	UART5_TX	TSC_G3_IO4	-	LCD_COM6/LCD_SEG30/LCD_SEG42	SDMMC_CK	SAI2_SD_B	-	EVENTOUT
	PC13	-	-	-	-	-	-	-	EVENTOUT
	PC14	-	-	-	-	-	-	-	EVENTOUT
	PC15	-	-	-	-	-	-	-	EVENTOUT

Table 16. Alternate function AF8 to AF15 (for AF0 to AF7 see *Table 15*) (continued)

Port		AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		UART4, UART5, LPUART1	**CAN1, TSC**	**OTG_FS, QUADSPI**	**LCD**	**SDMMC, COMP1, COMP2, FMC, SWPMI1**	**SAI1, SAI2**	**TIM2, TIM15, TIM16, TIM17, LPTIM2**	**EVENTOUT**
Port D	PD0	-	CAN1_RX	-	-	FMC_D2	-	-	EVENTOUT
	PD1	-	CAN1_TX	-	-	FMC_D3	-	-	EVENTOUT
	PD2	UART5_RX	-	-	LCD_COM7/ LCD_SEG31/ LCD_SEG43	SDMMC_CMD	-	-	EVENTOUT
	PD3	-	-	-	-	FMC_CLK	-	-	EVENTOUT
	PD4	-	-	-	-	FMC_NOE	-	-	EVENTOUT
	PD5	-	-	-	-	FMC_NWE	-	-	EVENTOUT
	PD6	-	-	-	-	FMC_NWAIT	SAI1_SD_A	-	EVENTOUT
	PD7	-	-	-	-	FMC_NE1	-	-	EVENTOUT
	PD8	-	-	-	LCD_SEG28	FMC_D13	-	-	EVENTOUT
	PD9	-	-	-	LCD_SEG29	FMC_D14	SAI2_MCK_A	-	EVENTOUT
	PD10	-	TSC_G6_IO1	-	LCD_SEG30	FMC_D15	SAI2_SCK_A	-	EVENTOUT
	PD11	-	TSC_G6_IO2	-	LCD_SEG31	FMC_A16	SAI2_SD_A	LPTIM2_ETR	EVENTOUT
	PD12	-	TSC_G6_IO3	-	LCD_SEG32	FMC_A17	SAI2_FS_A	LPTIM2_IN1	EVENTOUT
	PD13	-	TSC_G6_IO4	-	LCD_SEG33	FMC_A18	-	LPTIM2_OUT	EVENTOUT
	PD14	-	-	-	LCD_SEG34	FMC_D0	-	-	EVENTOUT
	PD15	-	-	-	LCD_SEG35	FMC_D1	-	-	EVENTOUT

Table 16. Alternate function AF8 to AF15 (for AF0 to AF7 see *Table 15*) (continued)

Port		AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		UART4, UART5, LPUART1	**CAN1, TSC**	**OTG_FS, QUADSPI**	**LCD**	**SDMMC, COMP1, COMP2, FMC, SWPMI1**	**SAI1, SAI2**	**TIM2, TIM15, TIM16, TIM17, LPTIM2**	**EVENTOUT**
Port E	PE0	-	-	-	LCD_SEG36	FMC_NBL0	-	TIM16_CH1	EVENTOUT
	PE1	-	-	-	LCD_SEG37	FMC_NBL1	-	TIM17_CH1	EVENTOUT
	PE2	-	TSC_G7_IO1	-	LCD_SEG38	FMC_A23	SAI1_MCLK_A	-	EVENTOUT
	PE3	-	TSC_G7_IO2	-	LCD_SEG39	FMC_A19	SAI1_SD_B	-	EVENTOUT
	PE4	-	TSC_G7_IO3	-	-	FMC_A20	SAI1_FS_A	-	EVENTOUT
	PE5	-	TSC_G7_IO4	-	-	FMC_A21	SAI1_SCK_A	-	EVENTOUT
	PE6	-	-	-	-	FMC_A22	SAI1_SD_A	-	EVENTOUT
	PE7	-	-	-	-	FMC_D4	SAI1_SD_B	-	EVENTOUT
	PE8	-	-	-	-	FMC_D5	SAI1_SCK_B	-	EVENTOUT
	PE9	-	-	-	-	FMC_D6	SAI1_FS_B	-	EVENTOUT
	PE10	-	TSC_G5_IO1	QUADSPI_CLK	-	FMC_D7	SAI1_MCK_B	-	EVENTOUT
	PE11	-	TSC_G5_IO2	QUADSPI_NCS	-	FMC_D8	-	-	EVENTOUT
	PE12	-	TSC_G5_IO3	QUADSPI_BK1_IO0	-	FMC_D9	-	-	EVENTOUT
	PE13	-	TSC_G5_IO4	QUADSPI_BK1_IO1	-	FMC_D10	-	-	EVENTOUT
	PE14	-	-	QUADSPI_BK1_IO2	-	FMC_D11	-	-	EVENTOUT
	PE15	-	-	QUADSPI_BK1_IO3	-	FMC_D12	-	-	EVENTOUT

Table 16. Alternate function AF8 to AF15 (for AF0 to AF7 see *Table 15*) (continued)

Port		AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		UART4, UART5, LPUART1	**CAN1, TSC**	**OTG_FS, QUADSPI**	**LCD**	**SDMMC, COMP1, COMP2, FMC, SWPMI1**	**SAI1, SAI2**	**TIM2, TIM15, TIM16, TIM17, LPTIM2**	**EVENTOUT**
Port F	PF0	-	-	-	-	FMC_A0	-	-	EVENTOUT
	PF1	-	-	-	-	FMC_A1	-	-	EVENTOUT
	PF2	-	-	-	-	FMC_A2	-	-	EVENTOUT
	PF3	-	-	-	-	FMC_A3	-	-	EVENTOUT
	PF4	-	-	-	-	FMC_A4	-	-	EVENTOUT
	PF5	-	-	-	-	FMC_A5	-	-	EVENTOUT
	PF6	-	-	-	-	-	SAI1_SD_B	-	EVENTOUT
	PF7	-	-	-	-	-	SAI1_MCK_B	-	EVENTOUT
	PF8	-	-	-	-	-	SAI1_SCK_B	-	EVENTOUT
	PF9	-	-	-	-	-	SAI1_FS_B	TIM15_CH1	EVENTOUT
	PF10	-	-	-	-	-	-	TIM15_CH2	EVENTOUT
	PF11	-	-	-	-	-	-	-	EVENTOUT
	PF12	-	-	-	-	FMC_A6	-	-	EVENTOUT
	PF13	-	-	-	-	FMC_A7	-	-	EVENTOUT
	PF14	-	TSC_G8_IO1	-	-	FMC_A8	-	-	EVENTOUT
	PF15	-	TSC_G8_IO2	-	-	FMC_A9	-	-	EVENTOUT

Table 16. Alternate function AF8 to AF15 (for AF0 to AF7 see *Table 15*) (continued)

Port		AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		UART4, UART5, LPUART1	CAN1, TSC	OTG_FS, QUADSPI	LCD	SDMMC, COMP1, COMP2, FMC, SWPMI1	SAI1, SAI2	TIM2, TIM15, TIM16, TIM17, LPTIM2	EVENTOUT
Port G	PG0	-	TSC_G8_IO3	-	-	FMC_A10	-	-	EVENTOUT
	PG1	-	TSC_G8_IO4	-	-	FMC_A11	-	-	EVENTOUT
	PG2	-	-	-	-	FMC_A12	SAI2_SCK_B	-	EVENTOUT
	PG3	-	-	-	-	FMC_A13	SAI2_FS_B	-	EVENTOUT
	PG4	-	-	-	-	FMC_A14	SAI2_MCK_B	-	EVENTOUT
	PG5	LPUART1_ CTS	-	-	-	FMC_A15	SAI2_SD_B	-	EVENTOUT
	PG6	LPUART1_ RTS_DE	-	-	-	-	-	-	EVENTOUT
	PG7	LPUART1_TX	-	-	-	FMC_INT3	-	-	EVENTOUT
	PG8	LPUART1_ RX	-	-	-	-	-	-	EVENTOUT
	PG9	-	-	-	-	FMC_NCE3/FMC_N E2	SAI2_SCK_A	TIM15_CH1N	EVENTOUT
	PG10	-	-	-	-	FMC_NE3	SAI2_FS_A	TIM15_CH1	EVENTOUT
	PG11	-	-	-	-	-	SAI2_MCK_A	TIM15_CH2	EVENTOUT
	PG12	-	-	-	-	FMC_NE4	SAI2_SD_A	-	EVENTOUT
	PG13	-	-	-	-	FMC_A24	-	-	EVENTOUT
	PG14	-	-	-	-	FMC_A25	-	-	EVENTOUT
	PG15	-	-	-	-	-	-	-	EVENTOUT
Port H	PH0	-	-	-	-	-	-	-	EVENTOUT
	PH1	-	-	-	-	-	-	-	EVENTOUT

5 Memory mapping

Figure 9. STM32L476 memory map

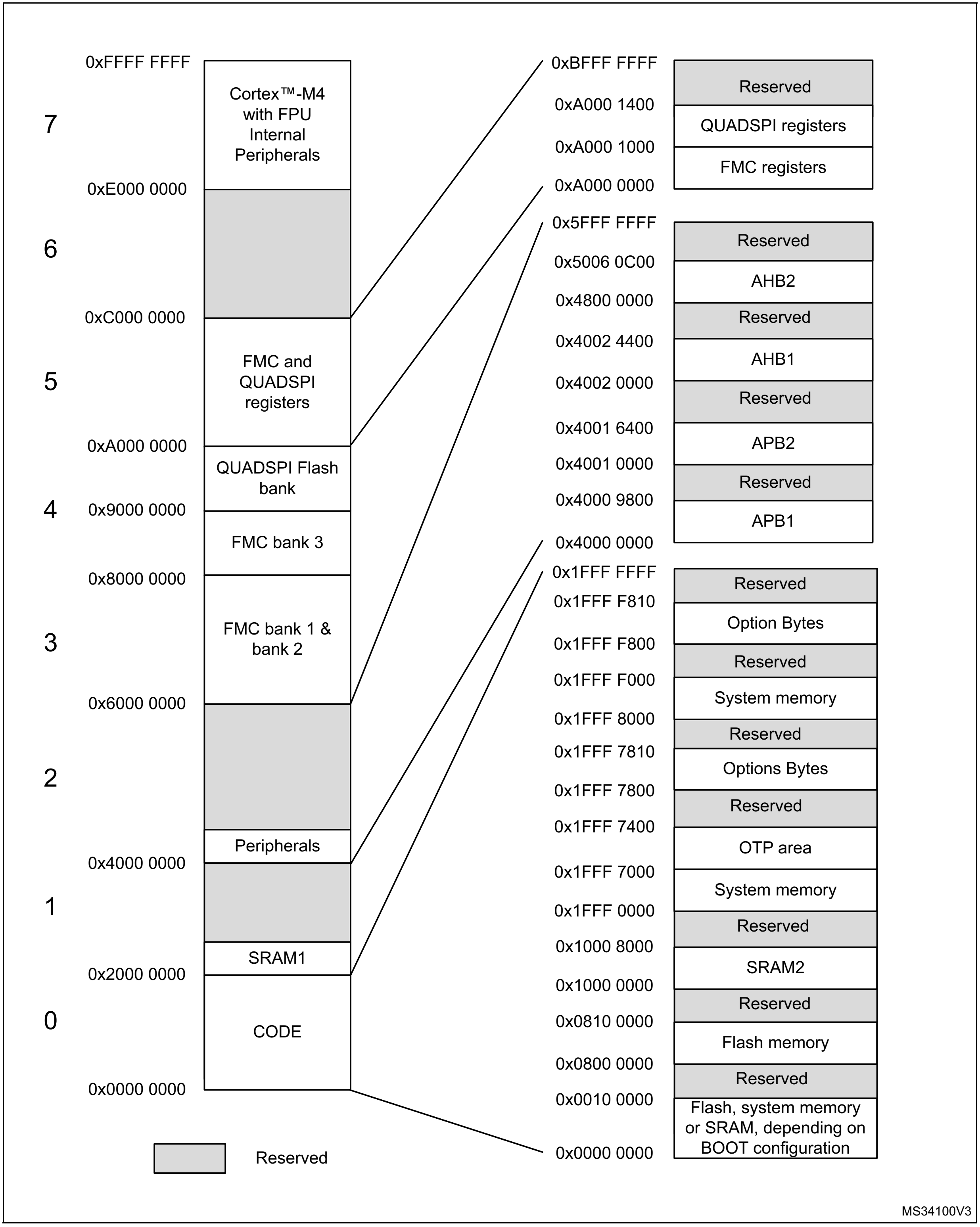


Table 17. STM32L476xx memory map and peripheral register boundary addresses (1)

Bus	Boundary address	Size (bytes)	Peripheral
AHB2	0x5006 0800 - 0x5006 0BFF	1 KB	RNG
	0x5004 0400 - 0x5006 07FF	129 KB	Reserved
	0x5004 0000 - 0x5004 03FF	1 KB	ADC
	0x5000 0000 - 0x5003 FFFF	16 KB	OTG_FS
	0x4800 2000 - 0x4FFF FFFF	~127 MB	Reserved
	0x4800 1C00 - 0x4800 1FFF	1 KB	GPIOH
	0x4800 1800 - 0x4800 1BFF	1 KB	GPIOG
	0x4800 1400 - 0x4800 17FF	1 KB	GPIOF
	0x4800 1000 - 0x4800 13FF	1 KB	GPIOE
	0x4800 0C00 - 0x4800 0FFF	1 KB	GPIOD
	0x4800 0800 - 0x4800 0BFF	1 KB	GPIOC
	0x4800 0400 - 0x4800 07FF	1 KB	GPIOB
	0x4800 0000 - 0x4800 03FF	1 KB	GPIOA
-	0x4002 4400 - 0x47FF FFFF	~127 MB	Reserved
AHB1	0x4002 4000 - 0x4002 43FF	1 KB	TSC
	0x4002 3400 - 0x4002 3FFF	1 KB	Reserved
	0x4002 3000 - 0x4002 33FF	1 KB	CRC
	0x4002 2400 - 0x4002 2FFF	3 KB	Reserved
	0x4002 2000 - 0x4002 23FF	1 KB	FLASH registers
	0x4002 1400 - 0x4002 1FFF	3 KB	Reserved
	0x4002 1000 - 0x4002 13FF	1 KB	RCC
	0x4002 0800 - 0x4002 0FFF	2 KB	Reserved
	0x4002 0400 - 0x4002 07FF	1 KB	DMA2
	0x4002 0000 - 0x4002 03FF	1 KB	DMA1
APB2	0x4001 6400 - 0x4001 FFFF	39 KB	Reserved
	0x4001 6000 - 0x4000 63FF	1 KB	DFSDM
	0x4001 5C00 - 0x4000 5FFF	1 KB	Reserved
	0x4001 5800 - 0x4000 5BFF	1 KB	SAI2
	0x4001 5400 - 0x4000 57FF	1 KB	SAI1
	0x4001 4C00 - 0x4000 53FF	2 KB	Reserved
	0x4001 4800 - 0x4001 4BFF	1 KB	TIM17
	0x4001 4400 - 0x4001 47FF	1 KB	TIM16
	0x4001 4000 - 0x4001 43FF	1 KB	TIM15

Table 17. STM32L476xx memory map and peripheral register boundary addresses (continued)(1)

Bus	Boundary address	Size (bytes)	Peripheral
APB2	0x4001 3C00 - 0x4001 3FFF	1 KB	Reserved
	0x4001 3800 - 0x4001 3BFF	1 KB	USART1
	0x4001 3400 - 0x4001 37FF	1 KB	TIM8
	0x4001 3000 - 0x4001 33FF	1 KB	SPI1
	0x4001 2C00 - 0x4001 2FFF	1 KB	TIM1
	0x4001 2800 - 0x4001 2BFF	1 KB	SDMMC
	0x4001 2000 - 0x4001 27FF	2 KB	Reserved
	0x4001 1C00 - 0x4001 1FFF	1 KB	FIREWALL
	0x4001 0800- 0x4001 1BFF	5 KB	Reserved
	0x4001 0400 - 0x4001 07FF	1 KB	EXTI
	0x4001 0200 - 0x4001 03FF	1 KB	COMP
	0x4001 0030 - 0x4001 01FF		VREFBUF
	0x4001 0000 - 0x4001 002F		SYSCFG
APB1	0x4000 9800 - 0x4000 FFFF	26 KB	Reserved
	0x4000 9400 - 0x4000 97FF	1 KB	LPTIM2
	0x4000 8C00 - 0x4000 93FF	2 KB	Reserved
	0x4000 8800 - 0x4000 8BFF	1 KB	SWPMI1
	0x4000 8400 - 0x4000 87FF	1 KB	Reserved
	0x4000 8000 - 0x4000 83FF	1 KB	LPUART1
	0x4000 7C00 - 0x4000 7FFF	1 KB	LPTIM1
	0x4000 7800 - 0x4000 7BFF	1 KB	OPAMP
	0x4000 7400 - 0x4000 77FF	1 KB	DAC
	0x4000 7000 - 0x4000 73FF	1 KB	PWR
	0x4000 6800 - 0x4000 6FFF	1 KB	Reserved
	0x4000 6400 - 0x4000 67FF	1 KB	CAN1
	0x4000 6000 - 0x4000 63FF	1 KB	Reserved
	0x4000 5C00- 0x4000 5FFF	1 KB	I2C3
	0x4000 5800 - 0x4000 5BFF	1 KB	I2C2
	0x4000 5400 - 0x4000 57FF	1 KB	I2C1
	0x4000 5000 - 0x4000 53FF	1 KB	UART5
	0x4000 4C00 - 0x4000 4FFF	1 KB	UART4
	0x4000 4800 - 0x4000 4BFF	1 KB	USART3
	0x4000 4400 - 0x4000 47FF	1 KB	USART2

Table 17. STM32L476xx memory map and peripheral register boundary addresses (continued)(1)

Bus	Boundary address	Size (bytes)	Peripheral
APB1	0x4000 4000 - 0x4000 43FF	1 KB	Reserved
	0x4000 3C00 - 0x4000 3FFF	1 KB	SPI3
	0x4000 3800 - 0x4000 3BFF	1 KB	SPI2
	0x4000 3400 - 0x4000 37FF	1 KB	Reserved
	0x4000 3000 - 0x4000 33FF	1 KB	IWDG
	0x4000 2C00 - 0x4000 2FFF	1 KB	WWDG
	0x4000 2800 - 0x4000 2BFF	1 KB	RTC
	0x4000 2400 - 0x4000 27FF	1 KB	LCD
	0x4000 1800 - 0x4000 23FF	3 KB	Reserved
	0x4000 1400 - 0x4000 17FF	1 KB	TIM7
	0x4000 1000 - 0x4000 13FF	1 KB	TIM6
	0x4000 0C00- 0x4000 0FFF	1 KB	TIM5
	0x4000 0800 - 0x4000 0BFF	1 KB	TIM4
	0x4000 0400 - 0x4000 07FF	1 KB	TIM3
	0x4000 0000 - 0x4000 03FF	1 KB	TIM2

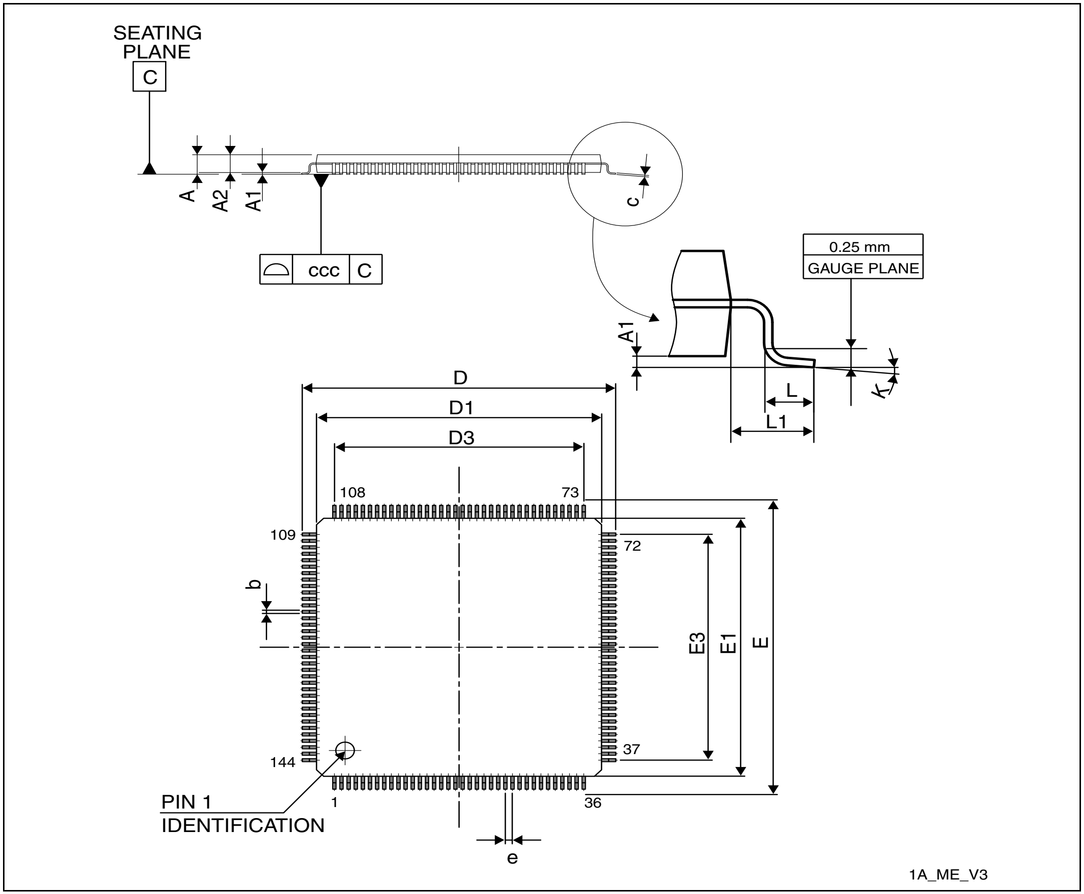
1. The grey color is used for reserved bondary addresses.

6 Package characteristics

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*. ECOPACK® is an ST trademark.

6.1 LQFP144 package mechanical data

Figure 10. LQFP144 - 144-pin, 20 x 20 mm low-profile quad flat package outline



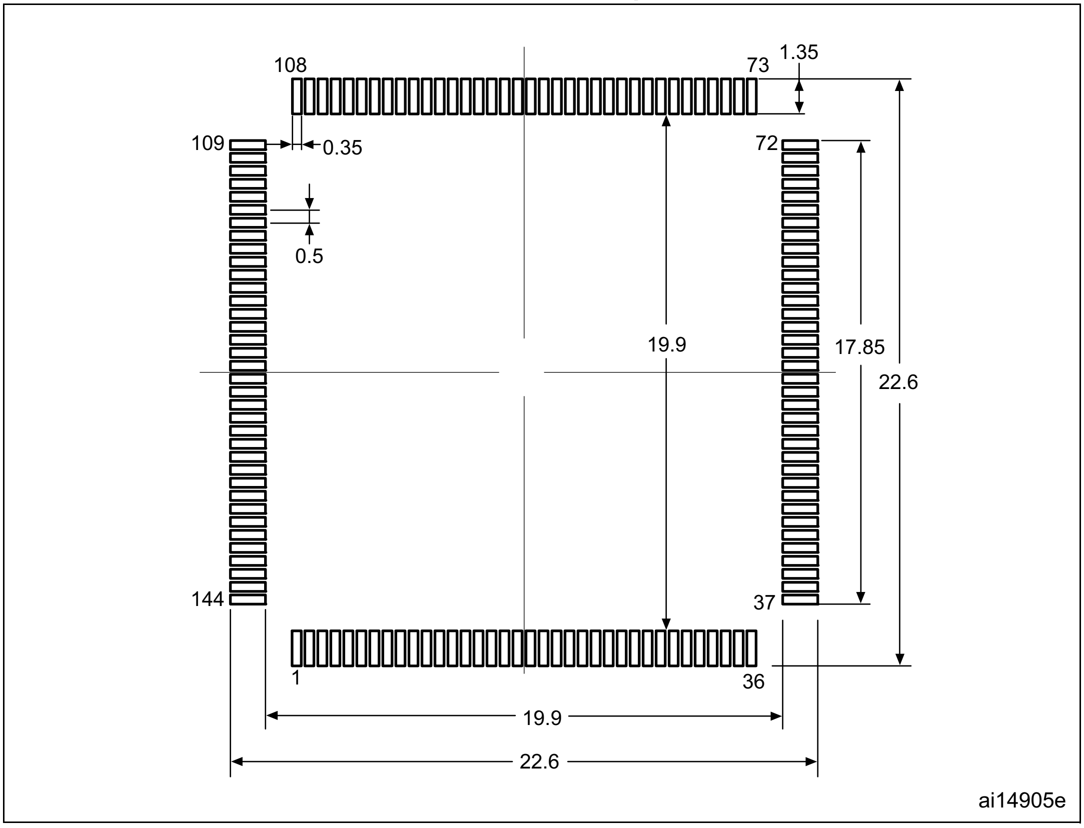
1. Drawing is not to scale. Dimensions are in millimeters.

Table 18. LQFP144 - 144-pin, 20 x 20 mm low-profile quad flat package mechanical data

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	-	-	1.600	-	-	0.0630
A1	0.050	-	0.150	0.0020	-	0.0059
A2	1.350	1.400	1.450	0.0531	0.0551	0.0571
b	0.170	0.220	0.270	0.0067	0.0087	0.0106
c	0.090	-	0.200	0.0035	-	0.0079
D	21.800	22.000	22.200	0.8583	0.8661	0.8740
D1	19.800	20.000	20.200	0.7795	0.7874	0.7953
D3	-	17.500	-	-	0.6890	-
E	21.800	22.000	22.200	0.8583	0.8661	0.8740
E1	19.800	20.000	20.200	0.7795	0.7874	0.7953
E3	-	17.500	-	-	0.6890	-
e	-	0.500	-	-	0.0197	-
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1	-	1.000	-	-	0.0394	-
k	0°	3.5°	7°	0°	3.5°	7°
ccc	-	-	0.080	-	-	0.0031

1. Values in inches are converted from mm and rounded to 4 decimal digits.

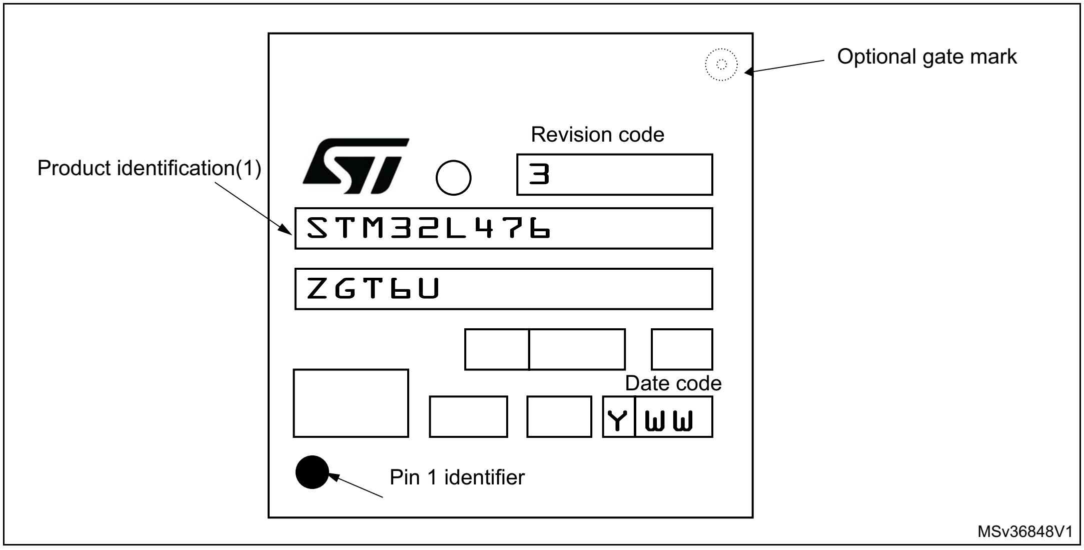
Figure 11. LQFP144 - 144-pin,20 x 20 mm low-profile quad flat package recommended footprint



1. Dimensions are expressed in millimeters.

Device marking

Figure 12. LQFP144 marking (package top view)

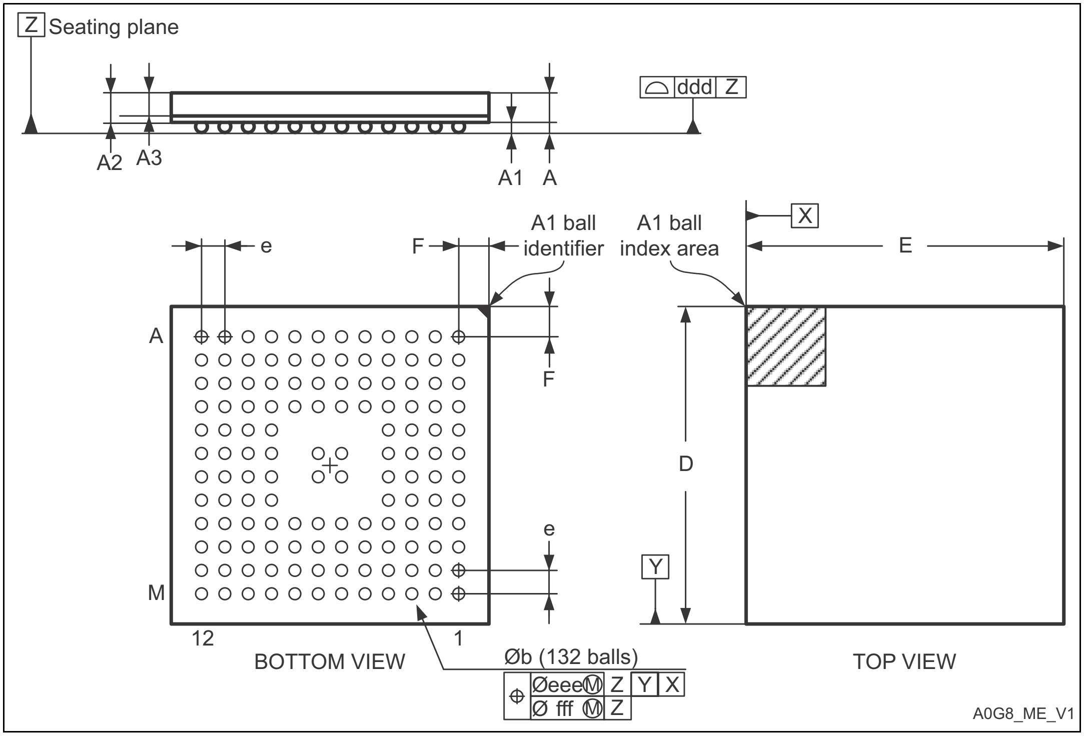


1. Parts marked as “ES”, “E” or accompanied by an Engineering Sample notification letter, are not yet

qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.

6.2 UFBGA132 package mechanical data

Figure 13. UFBGA132 - 132-pin, 7x7 mm ultra thin fine pitch ball grid array package outline



1. Drawing is not to scale. Dimensions are in millimeters.

Table 19. UFBGA132 - 132-pin, 7x7 mm ultra thin fine pitch ball grid array package mechanical data

Symbol	millimeters			inches[(1)]		
	Min	Typ	Max	Min	Typ	Max
A	0.460	0.530	0.600	0.0181	0.0209	0.0236
A1	0.050	0.080	0.110	0.0020	0.0031	0.0043
A2	0.400	0.450	0.500	0.0157	0.0177	0.0197
A3	0.270	0.320	0.370	0.0106	0.0126	0.0146
b	0.230	0.280	0.330	0.0091	0.0110	0.0130
D	6.950	7.000	7.050	0.2736	0.2756	0.2776
E	6.950	7.000	7.050	0.2736	0.2756	0.2776
e	-	0.500	-	-	0.0197	-
F	0.700	0.750	0.800	0.0276	0.0295	0.0315

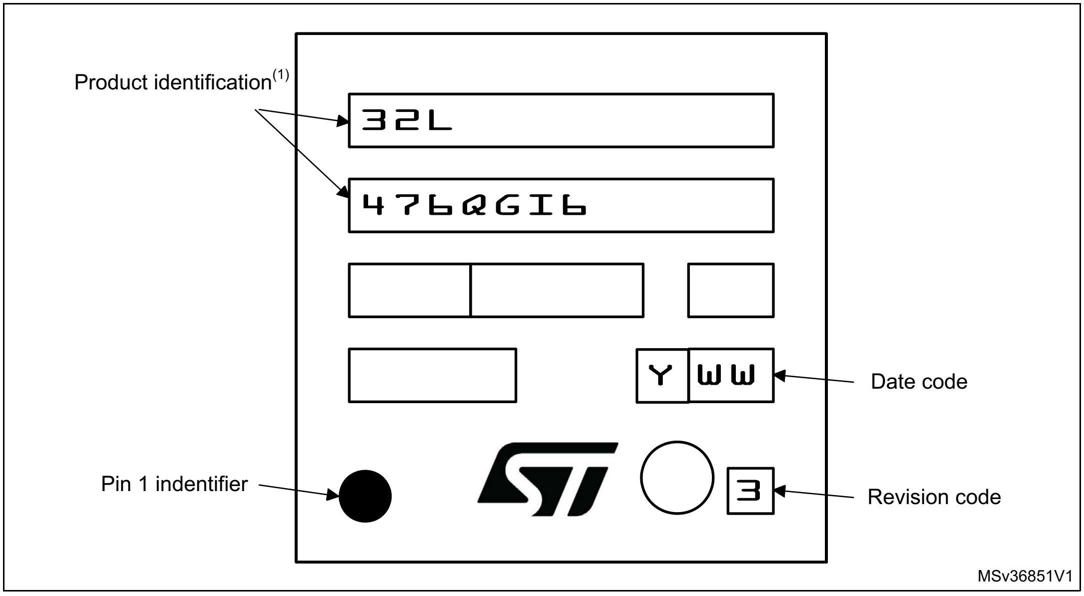
Table 19. UFBGA132 - 132-pin, 7x7 mm ultra thin fine pitch ball grid array package mechanical data (continued)

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
ddd	-	-	0.080	-	-	0.0031
eee	-	-	0.150	-	-	0.0059
fff	-	-	0.050	-	-	0.0020

1. Values in inches are converted from mm and rounded to 4 decimal digits.

Device marking

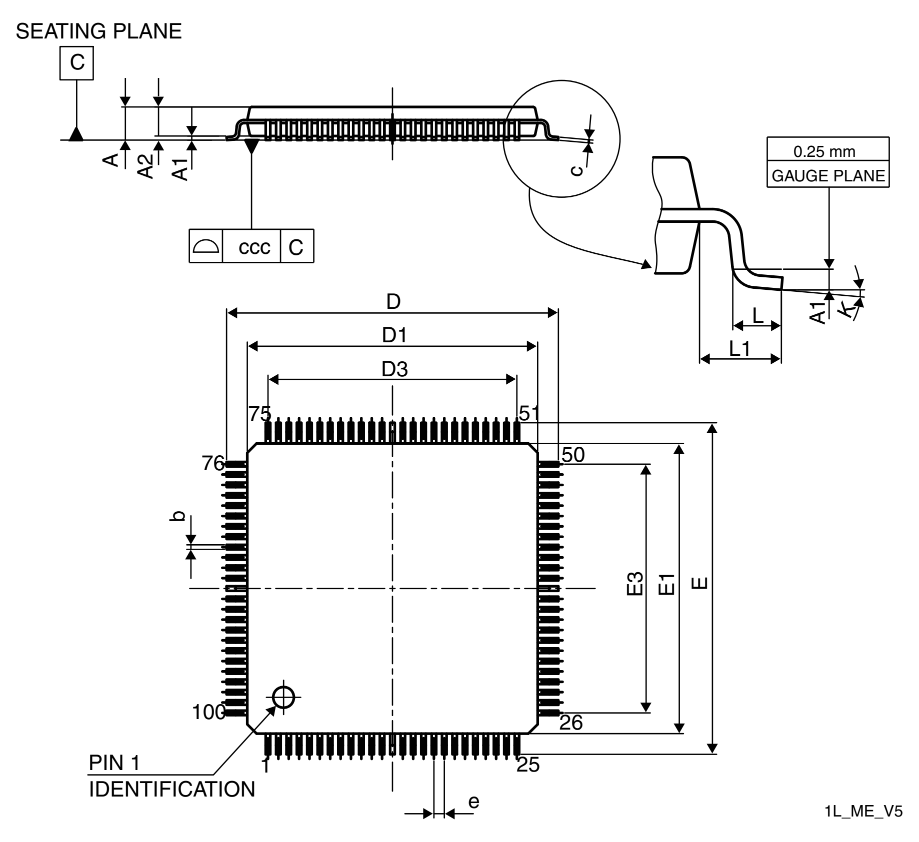
Figure 14. UFBGA132 marking (package top view)



1. Parts marked as “ES”, “E” or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.

6.3 LQFP100 package mechanical data

Figure 15. LQFP100 - 100-pin, 14 x 14 mm low-profile quad flat package outline



1. Drawing is not to scale. Dimensions are in millimeters.

Table 20. LQPF100 - 100-pin, 14 x 14 mm low-profile quad flat package mechanical data

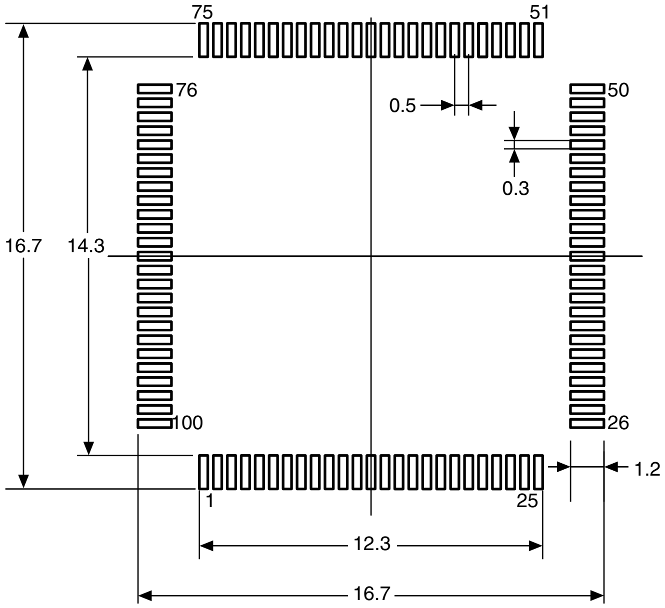
Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	-	-	1.600	-	-	0.0630
A1	0.050	-	0.150	0.0020	-	0.0059
A2	1.350	1.400	1.450	0.0531	0.0551	0.0571
b	0.170	0.220	0.270	0.0067	0.0087	0.0106
c	0.090	-	0.200	0.0035	-	0.0079
D	15.800	16.000	16.200	0.6220	0.6299	0.6378
D1	13.800	14.000	14.200	0.5433	0.5512	0.5591

Table 20. LQPF100 - 100-pin, 14 x 14 mm low-profile quad flat package mechanical data (continued)

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
D3	-	12.000	-	-	0.4724	-
E	15.800	16.000	16.200	0.6220	0.6299	0.6378
E1	13.800	14.000	14.200	0.5433	0.5512	0.5591
E3	-	12.000	-	-	0.4724	-
e	-	0.500	-	-	0.0197	-
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1	-	1.000	-	-	0.0394	-
k	0.0°	3.5°	7.0°	0.0°	3.5°	7.0°
ccc	-	-	0.080	-	-	0.0031

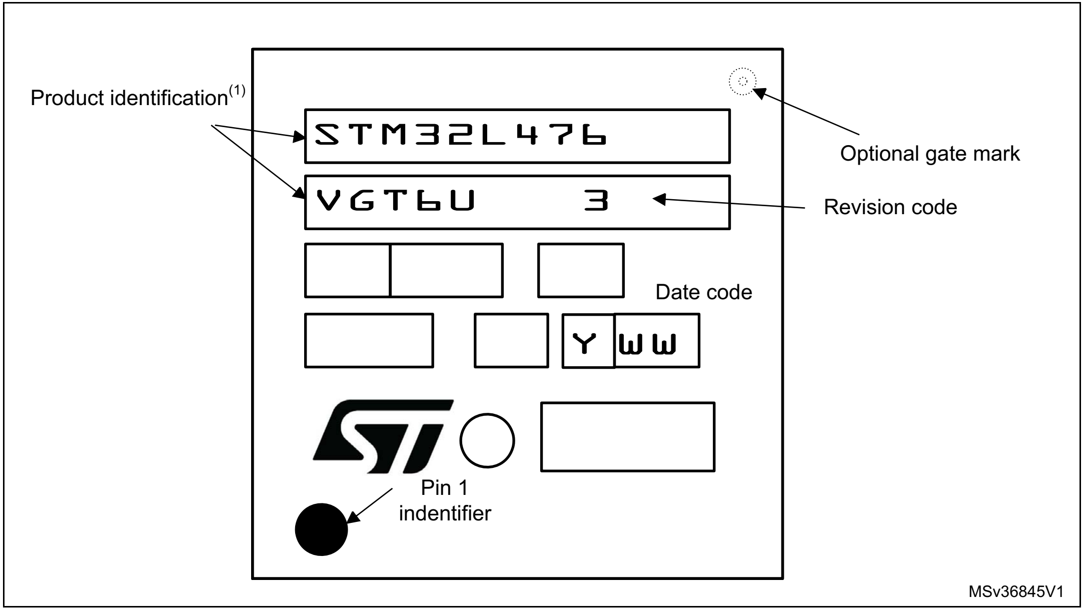
1. Values in inches are converted from mm and rounded to 4 decimal digits.

Figure 16. LQFP100 - 100-pin, 14 x 14 mm low-profile quad flat recommended footprint



Device marking

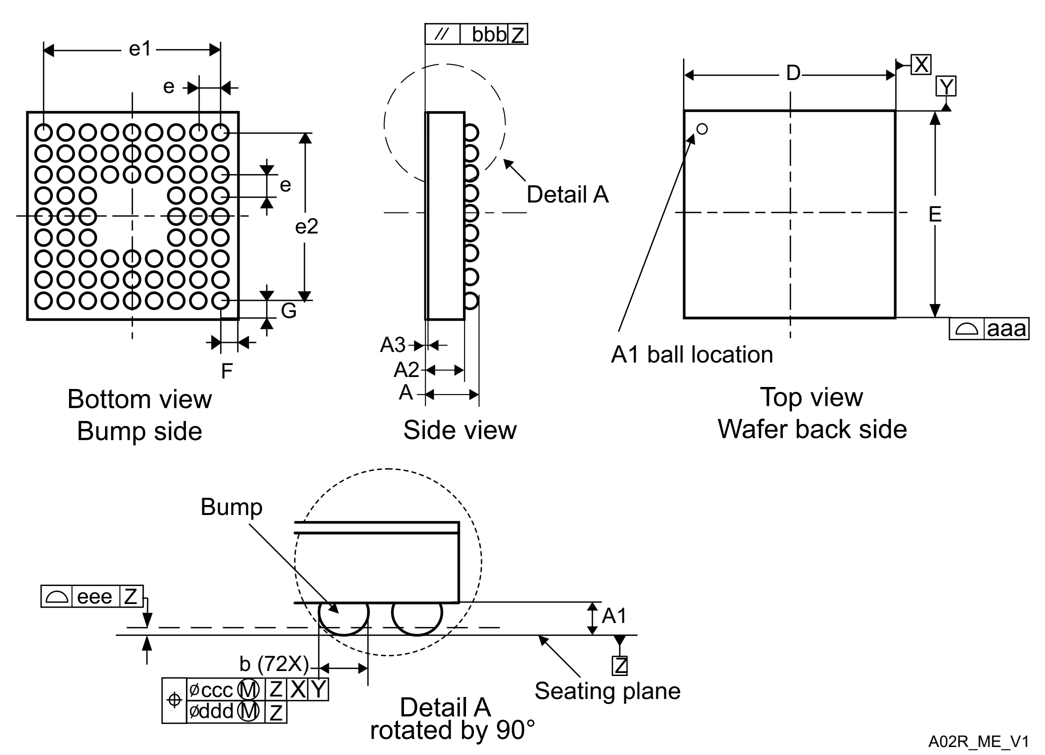
Figure 17. LQFP100 marking (package top view)



1. Parts marked as “ES”, “E” or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.

6.4 WLCSP72 package mechanical data

Figure 18. WLCSP72 - 72-pin, 4.4084 x 3.7594 mm, 0.4 mm pitch wafer level chip scale package outline



1. Drawing is not to scale.

Table 21. WLCSP72 - 72-pin, 4.4084 x 3.7594 mm, 0.4 mm pitch wafer level chip scale package mechanical data

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	0.525	0.555	0.585	0.0207	0.0219	0.0230
A1	-	0.175	-	-	0.0069	-
A2	-	0.380	-	-	0.0150	-
A3[2]	-	0.025	-	-	0.0010	-
b[3]	0.220	0.250	0.280	0.0087	0.0098	0.0110
D	4.3734	4.4084	4.4434	0.1722	0.1736	0.1749
E	3.7244	3.7594	3.7944	0.1466	0.1480	0.1494
e	-	0.400	-	-	0.0157	-
e1	-	3.200	-	-	0.1260	-
e2	-	3.200	-	-	0.1260	-
F	-	0.6042	-	-	0.0238	-

Table 21. WLCSP72 - 72-pin, 4.4084 x 3.7594 mm, 0.4 mm pitch wafer level chip scale package mechanical data (continued)

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
G	-	0.2797	-	-	0.0110	-
aaa	-	0.100	-	-	0.0039	-
bbb	-	0.100	-	-	0.0039	-
ccc	-	0.100	-	-	0.0039	-
ddd	-	0.050	-	-	0.0020	-
eee	-	0.050	-	-	0.0020	-

1. Values in inches are converted from mm and rounded to 4 decimal digits.
2. Back side coating
3. Dimension is measured at the maximum bump diameter parallel to primary datum Z.

Device marking

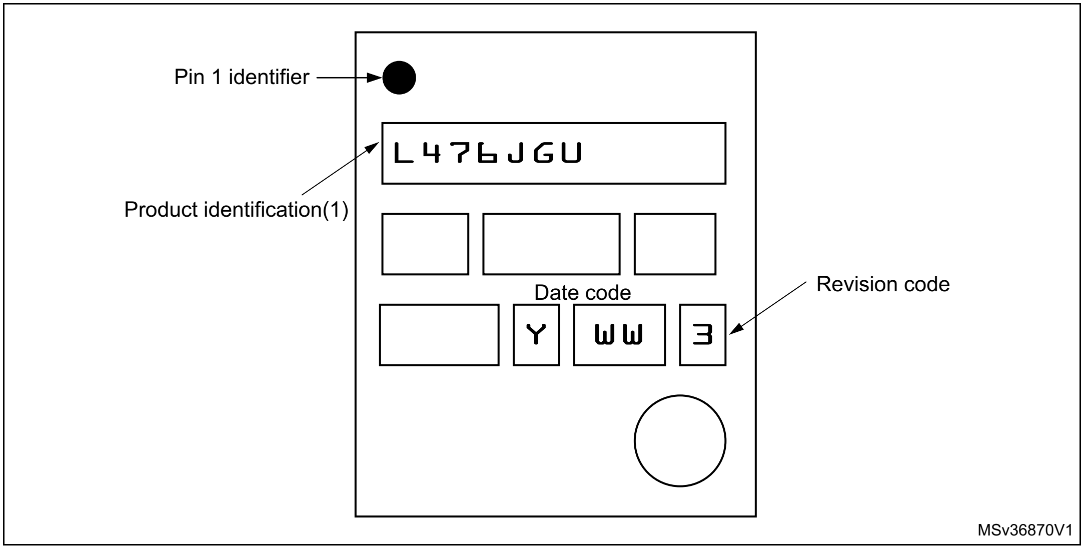
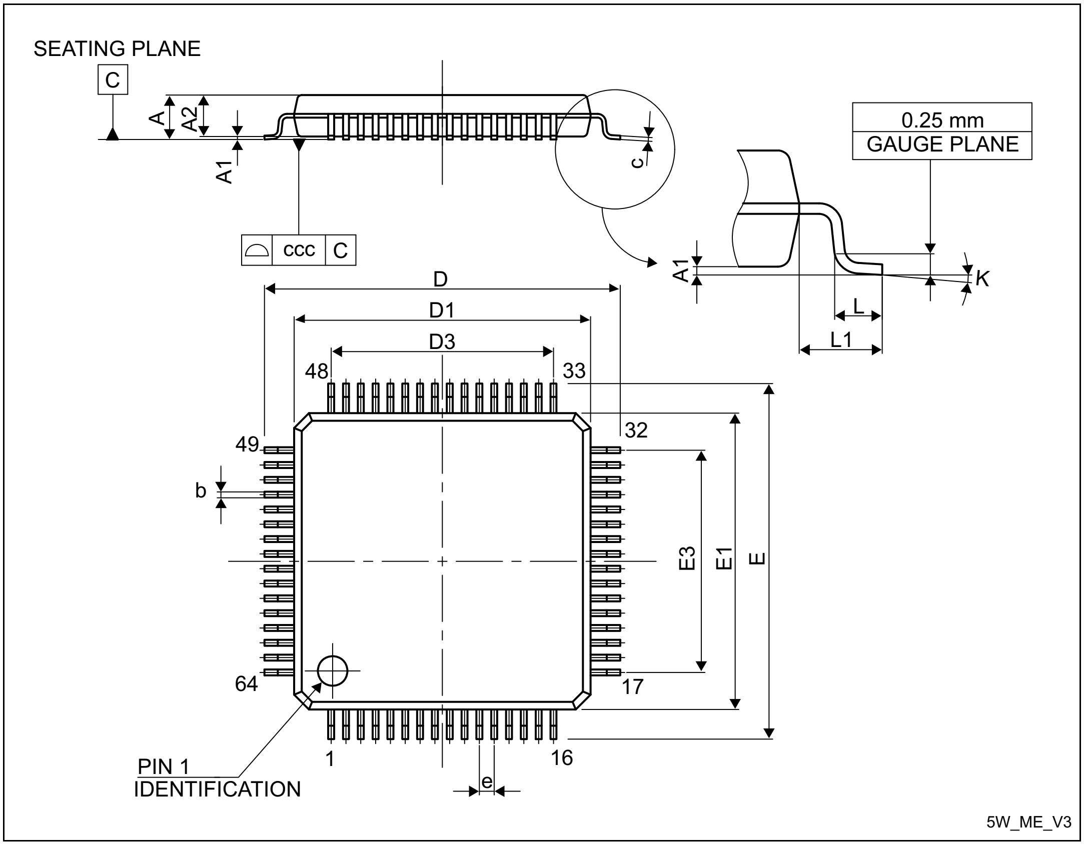


Figure 19. WLCSP72 marking (package top view)

1. Parts marked as “ES”, “E” or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.

6.5 LQFP64 package information

Figure 20. LQFP64 - 64-pin, 10 x 10 mm low-profile quad flat package outline



1. Drawing is not to scale.

Table 22. LQFP64 - 64-pin, 10 x 10 mm low-profile quad flat package mechanical data

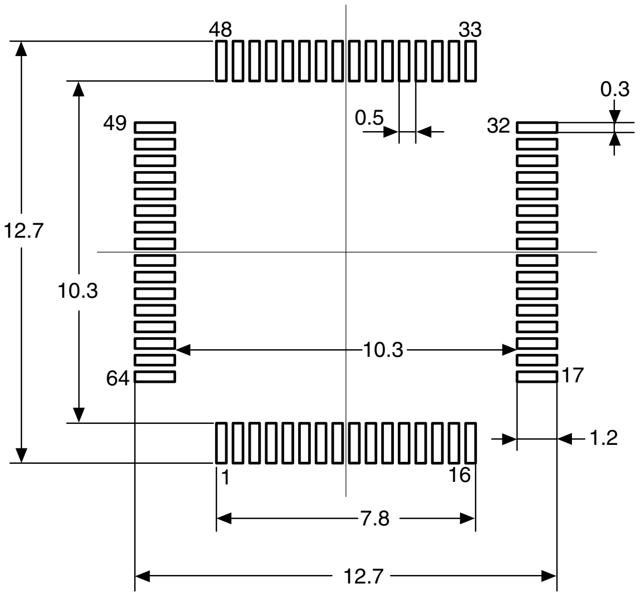
Symbol	millimeters			inches(1)		
	Min	Typ	Max	Min	Typ	Max
A	-	-	1.600	-	-	0.0630
A1	0.050	-	0.150	0.0020	-	0.0059
A2	1.350	1.400	1.450	0.0531	0.0551	0.0571
b	0.170	0.220	0.270	0.0067	0.0087	0.0106
c	0.090	-	0.200	0.0035	-	0.0079
D	-	12.000	-	-	0.4724	-
D1	-	10.000	-	-	0.3937	-
D3	-	7.500	-	-	0.2953	-
E	-	12.000	-	-	0.4724	-
E1	-	10.000	-	-	0.3937	-

Table 22. LQFP64 - 64-pin, 10 x 10 mm low-profile quad flat package mechanical data (continued)

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
E3	-	7.500	-	-	0.2953	-
e	-	0.500	-	-	0.0197	-
θ	0°	3.5°	7°	0°	3.5°	7°
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1	-	1.000	-	-	0.0394	-
ccc	-	-	0.080	-	-	0.0031

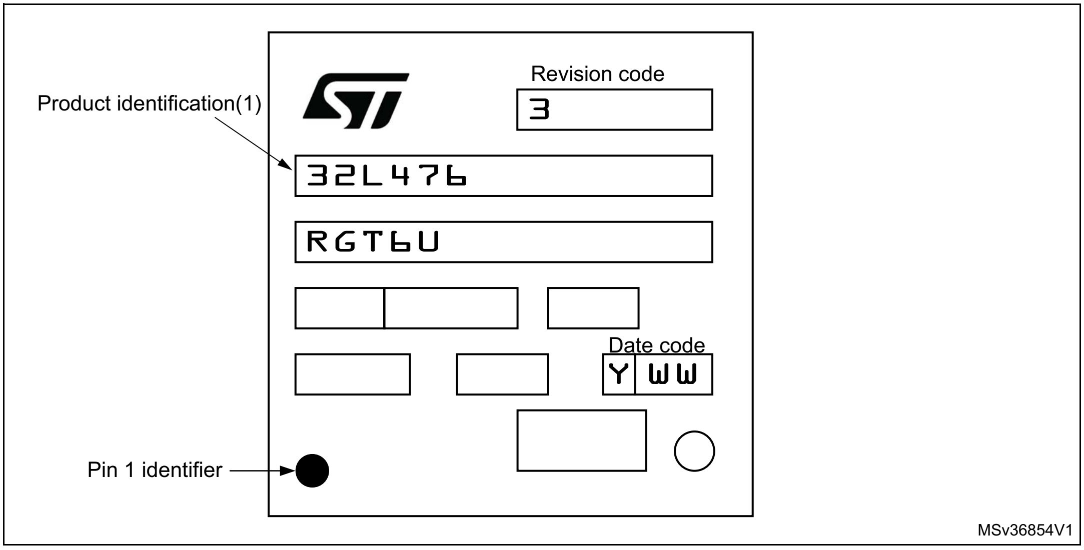
1. Values in inches are converted from mm and rounded to 4 decimal digits.

Figure 21. LQFP64 - 64-pin, 10 x 10 mm low-profile quad flat recommended footprint



Device marking

Figure 22. LQFP64 marking (package top view)



1. Parts marked as “ES”, “E” or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.

6.6 Thermal characteristics

The maximum chip junction temperature ($T_J$max) must never exceed the values given in *Table 20: General operating conditions*.

The maximum chip-junction temperature, T_J max, in degrees Celsius, may be calculated using the following equation:

$$T_J \text{ max} = T_A \text{ max} + (P_D \text{ max} \times \Theta_{JA})$$

Where:

- T_A max is the maximum ambient temperature in °C,
- Θ_{JA} is the package junction-to-ambient thermal resistance, in °C/W,
- P_D max is the sum of P_{INT} max and $P_{I/O}$ max (P_D max = P_{INT} max + $P_{I/O}$max),
- P_{INT} max is the product of I_{DD} and V_{DD}, expressed in Watts. This is the maximum chip internal power.

$P_{I/O}$ max represents the maximum power dissipation on output pins where:

$$P_{I/O} \text{ max} = \Sigma (V_{OL} \times I_{OL}) + \Sigma ((V_{DDIOx} - V_{OH}) \times I_{OH}),$$

taking into account the actual V_{OL} / I_{OL} and V_{OH} / I_{OH} of the I/Os at low and high level in the application.

Table 23. Package thermal characteristics

Symbol	Parameter	Value	Unit
Θ_{JA}	**Thermal resistance junction-ambient** LQFP64 - 10 × 10 mm / 0.5 mm pitch	45	°C/W
	Thermal resistance junction-ambient LQFP100 - 14 × 14mm	42	
	Thermal resistance junction-ambient LQFP144 - 20 × 20 mm	32	
	Thermal resistance junction-ambient UFBGA132 - 7 × 7 mm	55	
	Thermal resistance junction-ambient WLCSP72	46	

6.6.1 Reference document

JESD51-2 Integrated Circuits Thermal Test Method Environment Conditions - Natural Convection (Still Air). Available from www.jedec.org

6.6.2 Selecting the product temperature range

When ordering the microcontroller, the temperature range is specified in the ordering information scheme shown in *Section 7: Part numbering*.

Each temperature range suffix corresponds to a specific guaranteed ambient temperature at maximum dissipation and, to a specific maximum junction temperature.

As applications do not commonly use the STM32L476xx at maximum dissipation, it is useful to calculate the exact power consumption and junction temperature to determine which temperature range will be best suited to the application.

The following examples show how to calculate the temperature range needed for a given application.

Example 1: High-performance application

Assuming the following application conditions:

Maximum ambient temperature T_{Amax} = 82 °C (measured according to JESD51-2), I_{DDmax} = 50 mA, V_{DD} = 3.5 V, maximum 20 I/Os used at the same time in output at low level with I_{OL} = 8 mA, V_{OL}= 0.4 V and maximum 8 I/Os used at the same time in output at low level with I_{OL} = 20 mA, V_{OL}= 1.3 V

P_{INTmax} = 50 mA × 3.5 V= 175 mW

P_{IOmax} = 20 × 8 mA × 0.4 V + 8 × 20 mA × 1.3 V = 272 mW

This gives: P_{INTmax} = 175 mW and P_{IOmax} = 272 mW:

P_{Dmax} = 175 + 272 = 447 mW

Using the values obtained in *Table 23* T_{Jmax} is calculated as follows:

– For LQFP64, 45 °C/W

T_{Jmax} = 82 °C + (45 °C/W × 447 mW) = 82 °C + 20.115 °C = 102.115 °C

This is within the range of the suffix 6 version parts (–40 < T_J < 105 °C) see *Section 7: Part numbering*.

In this case, parts must be ordered at least with the temperature range suffix 6 (see Part numbering).

Note: *With this given P_{Dmax} we can find the T_{Amax} allowed for a given device temperature range (order code suffix 6 or 7).*

Suffix 6: T_{Amax} = T_{Jmax} - (45°C/W × 447 mW) = 105-20.115 = 84.885 °C

Suffix 7: T_{Amax} = T_{Jmax} - (45°C/W × 447 mW) = 125-20.115 = 104.885 °C

Example 2: High-temperature application

Using the same rules, it is possible to address applications that run at high ambient temperatures with a low dissipation, as long as junction temperature T_J remains within the specified range.

Assuming the following application conditions:

Maximum ambient temperature T_{Amax} = 100 °C (measured according to JESD51-2), I_{DDmax} = 20 mA, V_{DD} = 3.5 V, maximum 20 I/Os used at the same time in output at low level with I_{OL} = 8 mA, V_{OL}= 0.4 V

P_{INTmax} = 20 mA × 3.5 V= 70 mW

P_{IOmax} = 20 × 8 mA × 0.4 V = 64 mW

This gives: P_{INTmax} = 70 mW and P_{IOmax} = 64 mW:

P_{Dmax} = 70 + 64 = 134 mW

Thus: P_{Dmax} = 134 mW

Using the values obtained in *Table 23* T_{Jmax} is calculated as follows:

– For LQFP64, 45 °C/W

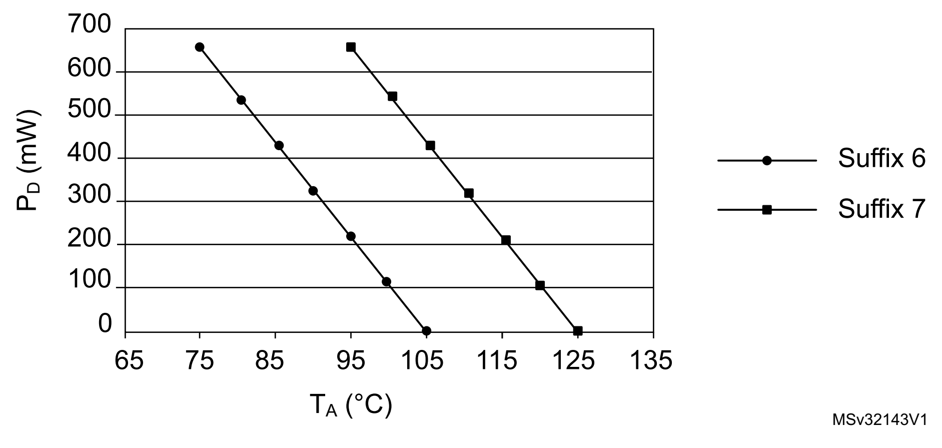
T_{Jmax} = 100 °C + (45 °C/W × 134 mW) = 100 °C + 6.03 °C = 106.03 °C

This is above the range of the suffix 6 version parts (–40 < T_J < 105 °C).

In this case, parts must be ordered at least with the temperature range suffix 7 (see *Section 7: Part numbering*) unless we reduce the power dissipation in order to be able to use suffix 6 parts.

Refer to *Figure 23* to select the required temperature range (suffix 6 or 7) according to your ambient temperature or power requirements.

Figure 23. LQFP64 P_D max vs. T_A



7 Part numbering

Table 24. STM32L476xx ordering information scheme

Example: STM32 L 476 R G T 6 TR

Device family

STM32 = ARM-based 32-bit microcontroller

Product type

L = Ultralow-power

Device subfamily

476: STM32L476xx

Pin count

R = 64 pins
J = 72 pins
V = 100 pins
Q = 132 pins
Z = 144 pins

Flash memory size

C = 256 KB of Flash memory
E = 512 KB of Flash memory
G = 1 MB of Flash memory

Package

T = LQFP ECOPACK®2
I = UFBGA ECOPACK®2
Y = CSP ECOPACK®2

Temperature range

6 = Industrial temperature range, -40 to 85 °C (105 °C junction)
7 = Industrial temperature range, -40 to 105 °C (125 °C junction)
3 = Industrial temperature range, -40 to 125 °C (130 °C junction)

Packing

TR = tape and reel
xxx = programmed parts

8 Revision history

Table 25. Document revision history

Date	Revision	Changes
13-Feb-2015	1	Initial release.
17-Feb-2015	2	Updated *Section 3.35: Flexible static memory controller (FSMC)*. Updated PB2 I/O structure in *Table 14: STM32L476xx pin definitions*. Updated title of *Figure 18: WLCSP72 - 72-pin, 4.4084 x 3.7594 mm, 0.4 mm pitch wafer level chip scale package outline* and *Table 21: WLCSP72 - 72-pin, 4.4084 x 3.7594 mm, 0.4 mm pitch wafer level chip scale package mechanical data*. Fixed double figure mistake in *Figure 19: WLCSP72 marking (package top view)*. Removed *Section 6.6: UFQFPN48 package mechanical data*.