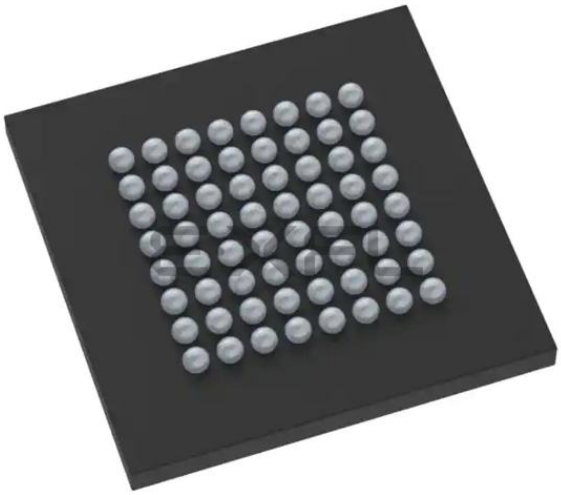

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"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M3
Core Size	32-Bit Single-Core
Speed	32MHz
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART, USB
Peripherals	Brown-out Detect/Reset, Cap Sense, DMA, I²S, POR, PWM, WDT
Number of I/O	51
Program Memory Size	384KB (384K x 8)
Program Memory Type	FLASH
EEPROM Size	12K x 8
RAM Size	48K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 3.6V
Data Converters	A/D 21x12b; D/A 2x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-UFBGA, WLCSP
Supplier Device Package	64-WLCSP (4.54x4.91)
Purchase URL	https://www.e-xfl.com/product-detail/stmicroelectronics/stm32l151rdy6tr

Contents

1 Introduction 10

2 Description 11

2.1 Device overview 12

2.2 Ultra-low-power device continuum 13

2.2.1 Performance 13

2.2.2 Shared peripherals 13

2.2.3 Common system strategy. 14

2.2.4 Features 14

3 Functional overview 15

3.1 Low-power modes 16

3.2 ARM® Cortex®-M3 core with MPU 20

3.3 Reset and supply management 21

3.3.1 Power supply schemes 21

3.3.2 Power supply supervisor 21

3.3.3 Voltage regulator 22

3.3.4 Boot modes 22

3.4 Clock management 23

3.5 Low-power real-time clock and backup registers 25

3.6 GPIOs (general-purpose inputs/outputs) 25

3.7 Memories 26

3.8 FSMC (flexible static memory controller) 26

3.9 DMA (direct memory access) 26

3.10 LCD (liquid crystal display) 27

3.11 ADC (analog-to-digital converter) 27

3.11.1 Temperature sensor 27

3.11.2 Internal voltage reference (V_{REFINT}) 28

3.12 DAC (digital-to-analog converter) 28

3.13 Operational amplifier 28

3.14 Ultra-low-power comparators and reference voltage 29

3.15 System configuration controller and routing interface 29

3.16 Touch sensing . . . 29
3.17 Timers and watchdogs . . . 30
3.17.1 General-purpose timers (TIM2, TIM3, TIM4, TIM5, TIM9, TIM10 and TIM11) . . . 30
3.17.2 Basic timers (TIM6 and TIM7) . . . 31
3.17.3 SysTick timer . . . 31
3.17.4 Independent watchdog (IWDG) . . . 31
3.17.5 Window watchdog (WWDG) . . . 31
3.18 Communication interfaces . . . 31
3.18.1 I²C bus . . . 31
3.18.2 Universal synchronous/asynchronous receiver transmitter (USART) . . . 32
3.18.3 Serial peripheral interface (SPI) . . . 32
3.18.4 Inter-integrated sound (I2S) . . . 32
3.18.5 SDIO . . . 32
3.18.6 Universal serial bus (USB) . . . 32
3.19 CRC (cyclic redundancy check) calculation unit . . . 33
3.20 Development support . . . 34
3.20.1 Serial wire JTAG debug port (SWJ-DP) . . . 34
3.20.2 Embedded Trace Macrocell™ . . . 34

4 Pin descriptions . . . 35

5 Memory mapping . . . 57

6 Electrical characteristics . . . 58
6.1 Parameter conditions . . . 58
6.1.1 Minimum and maximum values . . . 58
6.1.2 Typical values . . . 58
6.1.3 Typical curves . . . 58
6.1.4 Loading capacitor . . . 58
6.1.5 Pin input voltage . . . 58
6.1.6 Power supply scheme . . . 59
6.1.7 Optional LCD power supply scheme . . . 60
6.1.8 Current consumption measurement . . . 60
6.2 Absolute maximum ratings . . . 61
6.3 Operating conditions . . . 62
6.3.1 General operating conditions . . . 62

List of tables

Table 1. Device summary . . . 1
Table 2. Ultra-low-power STM32L151xD and STM32L152xD device features and peripheral counts . . . 12
Table 3. Functionalities depending on the operating power supply range . . . 17
Table 4. CPU frequency range depending on dynamic voltage scaling . . . 18
Table 5. Functionalities depending on the working mode (from Run/active down to standby) . . . 19
Table 6. Timer feature comparison . . . 30
Table 7. Legend/abbreviations used in the pinout table . . . 39
Table 8. STM32L151xD and STM32L152xD pin definitions . . . 40
Table 9. Alternate function input/output . . . 49
Table 10. Voltage characteristics . . . 61
Table 11. Current characteristics . . . 61
Table 12. Thermal characteristics . . . 62
Table 13. General operating conditions . . . 62
Table 14. Embedded reset and power control block characteristics . . . 63
Table 15. Embedded internal reference voltage calibration values . . . 65
Table 16. Embedded internal reference voltage . . . 65
Table 17. Current consumption in Run mode, code with data processing running from Flash . . . 67
Table 18. Current consumption in Run mode, code with data processing running from RAM . . . 68
Table 19. Current consumption in Sleep mode . . . 69
Table 20. Current consumption in Low-power run mode . . . 70
Table 21. Current consumption in Low-power sleep mode . . . 71
Table 22. Typical and maximum current consumptions in Stop mode . . . 72
Table 23. Typical and maximum current consumptions in Standby mode . . . 74
Table 24. Peripheral current consumption . . . 75
Table 25. Low-power mode wakeup timings . . . 78
Table 26. High-speed external user clock characteristics . . . 78
Table 27. Low-speed external user clock characteristics . . . 80
Table 28. HSE oscillator characteristics . . . 81
Table 29. LSE oscillator characteristics (f_{LSE} = 32.768 kHz) . . . 82
Table 30. HSI oscillator characteristics . . . 84
Table 31. LSI oscillator characteristics . . . 84
Table 32. MSI oscillator characteristics . . . 85
Table 33. PLL characteristics . . . 87
Table 34. RAM and hardware registers . . . 87
Table 35. Flash memory and data EEPROM characteristics . . . 88
Table 36. Flash memory and data EEPROM endurance and retention . . . 88
Table 37. Asynchronous non-multiplexed SRAM/PSRAM/NOR read timings . . . 90
Table 38. Asynchronous non-multiplexed SRAM/PSRAM/NOR write timings . . . 91
Table 39. Asynchronous multiplexed PSRAM/NOR read timings . . . 92
Table 40. Asynchronous multiplexed PSRAM/NOR write timings . . . 93
Table 41. Synchronous multiplexed NOR/PSRAM read timings . . . 95
Table 42. Synchronous multiplexed PSRAM write timings . . . 97
Table 43. Synchronous non-multiplexed NOR/PSRAM read timings . . . 98
Table 44. Synchronous non-multiplexed PSRAM write timings . . . 99
Table 45. EMS characteristics . . . 101
Table 46. EMI characteristics . . . 102

TIM10, TIM11 and TIM9

TIM10 and TIM11 are based on a 16-bit auto-reload upcounter. TIM9 is based on a 16-bit auto-reload up/down counter. They include a 16-bit prescaler. TIM10 and TIM11 feature one independent channel, whereas TIM9 has two independent channels for input capture/output compare, PWM or one-pulse mode output. They can be synchronized with the TIM2, TIM3, TIM4, TIM5 full-featured general-purpose timers.

They can also be used as simple time bases and be clocked by the LSE clock source (32.768 kHz) to provide time bases independent from the main CPU clock.

3.17.2 Basic timers (TIM6 and TIM7)

These timers are mainly used for DAC trigger generation. They can also be used as generic 16-bit time bases.

3.17.3 SysTick timer

This timer is dedicated to the OS, but could also be used as a standard downcounter. It is based on a 24-bit downcounter with autoreload capability and a programmable clock source. It features a maskable system interrupt generation when the counter reaches 0.

3.17.4 Independent watchdog (IWDG)

The independent watchdog is based on a 12-bit downcounter and 8-bit prescaler. It is clocked from an independent 37 kHz internal RC and, as it operates independently of 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.

3.17.5 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.

3.18 Communication interfaces

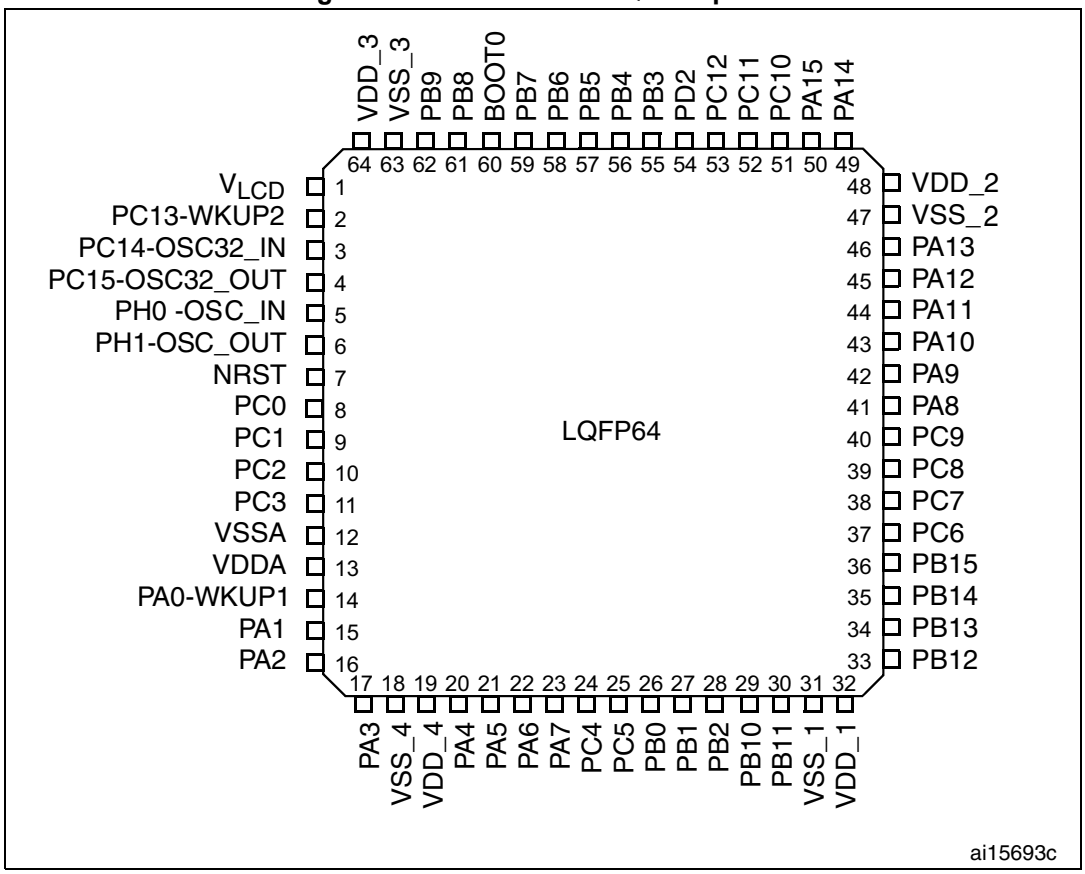
3.18.1 I²C bus

Up to two I²C bus interfaces can operate in multimaster and slave modes. They can support standard and fast modes.

They support dual slave addressing (7-bit only) and both 7- and 10-bit addressing in master mode. A hardware CRC generation/verification is embedded.

They can be served by DMA and they support SM Bus 2.0/PM Bus.

Figure 6. STM32L15xRD LQFP64 pinout



1. This figure shows the package top view.

Table 8. STM32L151xD and STM32L152xD pin definitions (continued)

Pins					Pin name	Pin Type(1)	I / O structure	Main function(2) (after reset)	Pin functions	
LQFP144	UFBGA132	LQFP100	LQFP64	WLCSP64					Alternate functions	Additional functions
79	J12	57	-	-	PD10	I/O	FT	PD10	USART3_CK/LCD_SEG30/ FSMC_D15	-
80	J11	58	-	-	PD11	I/O	FT	PD11	USART3_CTS/LCD_SEG31 /FSMC_A16	-
81	J10	59	-	-	PD12	I/O	FT	PD12	TIM4_CH1/USART3_RTS/ LCD_SEG32/ FSMC_A17	-
82	H12	60	-	-	PD13	I/O	FT	PD13	TIM4_CH2/LCD_SEG33/ FSMC_A18	-
83	-	-	-	-	V_{SS_8}	S	-	V_{SS_8}	-	-
84	-	-	-	-	V_{DD_8}	S	-	V_{DD_8}	-	-
85	H11	61	-	-	PD14	I/O	FT	PD14	TIM4_CH3/LCD_SEG34/ FSMC_D0	-
86	H10	62	-	-	PD15	I/O	FT	PD15	TIM4_CH4/LCD_SEG35 /FSMC_D1	-
87	G10	-	-	-	PG2	I/O	FT	PG2	FSMC_A12	ADC_IN10b
88	F9	-	-	-	PG3	I/O	FT	PG3	FSMC_A13	ADC_IN11b
89	F10	-	-	-	PG4	I/O	FT	PG4	FSMC_A14	ADC_IN12b
90	E9	-	-	-	PG5	I/O	FT	PG5	FSMC_A15	-
91	-	-	-	-	PG6	I/O	FT	PG6	-	-
92	-	-	-	-	PG7	I/O	FT	PG7	-	-
93	-	-	-	-	PG8	I/O	FT	PG8	-	-
94	F6	-	-	-	V_{SS_9}	S		V_{SS_9}	-	-
95	G6	-	-	-	V_{DD_9}	S		V_{DD_9}	-	-
96	E12	63	37	E1	PC6	I/O	FT	PC6	TIM3_CH1/I2S2_MCK/ LCD_SEG24/SDIO_D6	-
97	E11	64	38	E2	PC7	I/O	FT	PC7	TIM3_CH2/I2S3_MCK/ LCD_SEG25/SDIO_D7	-
98	E10	65	39	E3	PC8	I/O	FT	PC8	TIM3_CH3/LCD_SEG26/ SDIO_D0	-
99	D12	66	40	D1	PC9	I/O	FT	PC9	TIM3_CH4/LCD_SEG27/ SDIO_D1	-

Table 9. Alternate function input/output (continued)

Port name	Digital alternate function number														
	AFIO0	AFIO1	AFIO2	AFIO3	AFIO4	AFIO5	AFIO6	AFIO7	AFIO8	..	AFIO11	AFIO12	..	AFIO14	AFIO15
	Alternate function														
	SYSTEM	TIM2	TIM3/4/5	TIM9/ 10/11	I2C1/2	SPI1/2	SPI3	USART1/2/3	UART4/5		LCD	FSMC/ SDIO		CPRI	SYSTEM
PG5	-	-	-	-	-	-	-	-	-		-	A15		-	EVENT OUT
PG6	-	-	-	-	-	-	-	-	-		-	-		-	EVENT OUT
PG7	-	-	-	-	-	-	-	-	-		-	-		-	EVENT OUT
PG8	-	-	-	-	-	-	-	-	-		-	-		-	EVENT OUT
PG9	-	-	-	-	-	-	-	-	-		-	NE2		-	EVENT OUT
PG10	-	-	-	-	-	-	-	-	-		-	NE3		-	EVENT OUT
PG11	-	-	-	-	-	-	-	-	-		-	-		-	EVENT OUT
PG12	-	-	-	-	-	-	-	-	-		-	NE4		-	EVENT OUT
PG13	-	-	-	-	-	-	-	-	-		-	A24		-	EVENT OUT
PG14	-	-	-	-	-	-	-	-	-		-	A25		-	EVENT OUT
PG15	-	-	-	-	-	-	-	-	-		-	-		-	EVENT OUT
PH0OSC_IN	-	-	-	-	-	-	-	-	-		-	-		-	-
PH1OSC_OUT	-	-	-	-	-	-	-	-	-		-	-		-	-
PH2	-	-	-	-	-	-	-	-	-		-	A22		-	-

6 Electrical characteristics

6.1 Parameter conditions

Unless otherwise specified, all voltages are referenced to V_{SS}.

6.1.1 Minimum and maximum values

Unless otherwise specified the minimum and maximum values are guaranteed in the worst conditions of ambient temperature, supply voltage and frequencies by tests in production on 100% of the devices with an ambient temperature at T_A = 25 °C and T_A = $T_A$max (given by the selected temperature range).

Data based on characterization results, design simulation and/or technology characteristics are indicated in the table footnotes. Based on characterization, the minimum and maximum values refer to sample tests and represent the mean value plus or minus three times the standard deviation (mean ±3σ).

6.1.2 Typical values

Unless otherwise specified, typical data are based on T_A = 25 °C, V_{DD} = 3.6 V (for the 1.65 V ≤V_{DD} ≤3.6 V voltage range). They are given only as design guidelines and are not tested.

Typical ADC accuracy values are determined by characterization of a batch of samples from a standard diffusion lot over the full temperature range, where 95% of the devices have an error less than or equal to the value indicated (mean ±2σ).

6.1.3 Typical curves

Unless otherwise specified, all typical curves are given only as design guidelines and are not tested.

6.1.4 Loading capacitor

The loading conditions used for pin parameter measurement are shown in *Figure 9*.

6.1.5 Pin input voltage

The input voltage measurement on a pin of the device is described in *Figure 10*.

Figure 9. Pin loading conditions

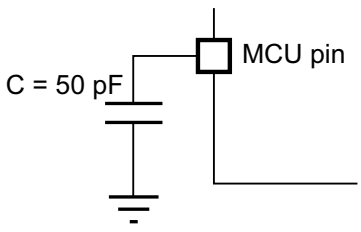
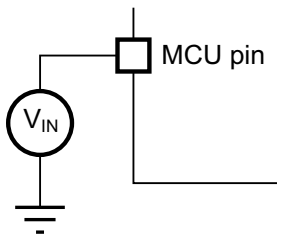


Figure 10. Pin input voltage



4. Positive current injection is not possible on these I/Os. A negative injection is induced by $V_{IN}<V_{SS}$. $I_{INJ(PIN)}$ must never be exceeded. Refer to *Table 10* for maximum allowed input voltage values.
5. A positive injection is induced by $V_{IN} > V_{DD}$ while a negative injection is induced by $V_{IN} < V_{SS}$. $I_{INJ(PIN)}$ must never be exceeded. Refer to *Table 10: Voltage characteristics* for the maximum allowed input voltage values.
6. When several inputs are submitted to a current injection, the maximum $\Sigma I_{INJ(PIN)}$ is the absolute sum of the positive and negative injected currents (instantaneous values).

Table 12. Thermal characteristics

Symbol	Ratings	Value	Unit
T_{STG}	Storage temperature range	–65 to +150	°C
T_J	Maximum junction temperature	150	°C

6.3 Operating conditions

6.3.1 General operating conditions

Table 13. General operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
f_{HCLK}	Internal AHB clock frequency	-	0	32	MHz
f_{PCLK1}	Internal APB1 clock frequency	-	0	32	
f_{PCLK2}	Internal APB2 clock frequency	-	0	32	
V_{DD}	Standard operating voltage	BOR detector disabled	1.65	3.6	V
		BOR detector enabled, at power on	1.8	3.6	
		BOR detector disabled, after power on	1.65	3.6	
V_{DDA}(1)	Analog operating voltage (ADC and DAC not used)	Must be the same voltage as V_{DD}(2)	1.65	3.6	V
	Analog operating voltage (ADC or DAC used)		1.8	3.6	
V_{IN}	I/O input voltage	FT pins; 2.0 V ≤V_{DD}	-0.3	5.5(3)	V
		FT pins; V_{DD} < 2.0 V	-0.3	5.25(3)	
		BOOT0 pin	0	5.5	
		Any other pin	-0.3	V_{DD}+0.3	
P_D	Power dissipation at TA = 85 °C for suffix 6 or TA = 105 °C for suffix 7(4)	LQFP144 package	-	500	mW
		LQFP100 package	-	465	
		LQFP64 package	-	435	
		UFBGA132	-	333	
		WLCSP64 package	-	435	
T_A	Ambient temperature for 6 suffix version	Maximum power dissipation(5)	–40	85	°C
	Ambient temperature for 7 suffix version	Maximum power dissipation	–40	105	

Table 14. Embedded reset and power control block characteristics (continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{BOR3}	Brown-out reset threshold 3	Falling edge	2.45	2.55	2.6	V
		Rising edge	2.54	2.66	2.7	
V_{BOR4}	Brown-out reset threshold 4	Falling edge	2.68	2.8	2.85	
		Rising edge	2.78	2.9	2.95	
V_{PVD0}	Programmable voltage detector threshold 0	Falling edge	1.8	1.85	1.88	
		Rising edge	1.88	1.94	1.99	
V_{PVD1}	PVD threshold 1	Falling edge	1.98	2.04	2.09	
		Rising edge	2.08	2.14	2.18	
V_{PVD2}	PVD threshold 2	Falling edge	2.20	2.24	2.28	
		Rising edge	2.28	2.34	2.38	
V_{PVD3}	PVD threshold 3	Falling edge	2.39	2.44	2.48	
		Rising edge	2.47	2.54	2.58	
V_{PVD4}	PVD threshold 4	Falling edge	2.57	2.64	2.69	
		Rising edge	2.68	2.74	2.79	
V_{PVD5}	PVD threshold 5	Falling edge	2.77	2.83	2.88	
		Rising edge	2.87	2.94	2.99	
V_{PVD6}	PVD threshold 6	Falling edge	2.97	3.05	3.09	
		Rising edge	3.08	3.15	3.20	
V_{hyst}	Hysteresis voltage	BOR0 threshold	-	40	-	mV
		All BOR and PVD thresholds excepting BOR0	-	100	-	

1. Guaranteed by characterization results.
2. Valid for device version without BOR at power up. Please see option “D” in Ordering information scheme for more details.

Table 22. Typical and maximum current consumptions in Stop mode (continued)

Symbol	Parameter	Conditions		Typ	Max(1)	Unit
I_{DD} (Stop)	Supply current in Stop mode (RTC disabled)	Regulator in LP mode, HSI and HSE OFF, independent watchdog and LSI enabled	T_A = -40°C to 25°C	1.6	2.2	µA
		Regulator in LP mode, LSI, HSI and HSE OFF (no independent watchdog)	T_A = -40°C to 25°C	0.475	1	
			T_A = 55°C	0.915	3	
			T_A= 85°C	3.35	9	
			T_A = 105°C	10.0	22(5)	
I_{DD} (WU from Stop)	Supply current during wakeup from Stop mode	MSI = 4.2 MHz	T_A = -40°C to 25°C	2	-	mA
		MSI = 1.05 MHz		1.45	-	
		MSI = 65 kHz(6)		1.45	-	

1. Guaranteed by characterization results, unless otherwise specified.
2. LCD enabled with external VLCD, static duty, division ratio = 256, all pixels active, no LCD connected.
3. LCD enabled with external VLCD, 1/8 duty, 1/3 bias, division ratio = 64, all pixels active, no LCD connected.
4. Based on characterization done with a 32.768 kHz crystal (MC306-G-06Q-32.768, manufacturer JFVNY) with two 6.8 pF loading capacitors.
5. Guaranteed by test in production.
6. When MSI = 64 kHz, the RMS current is measured over the first 15 µs following the wakeup event. For the remaining part of the wakeup period, the current corresponds the Run mode current.

6.3.7 Internal clock source characteristics

The parameters given in *Table 30* are derived from tests performed under the conditions summarized in *Table 13*.

High-speed internal (HSI) RC oscillator

Table 30. HSI oscillator characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{HSI}	Frequency	V_{DD} = 3.0 V	-	16	-	MHz
$TRIM^{(1)(2)}$	HSI user-trimmed resolution	Trimming code is not a multiple of 16	-	±0.4	0.7	%
		Trimming code is a multiple of 16	-	-	±1.5	%
$ACC_{HSI}^{(2)}$	Accuracy of the factory-calibrated HSI oscillator	V_{DDA} = 3.0 V, T_A = 25 °C	$-1^{(3)}$	-	$1^{(3)}$	%
		V_{DDA} = 3.0 V, T_A = 0 to 55 °C	-1.5	-	1.5	%
		V_{DDA} = 3.0 V, T_A = -10 to 70 °C	-2	-	2	%
		V_{DDA} = 3.0 V, T_A = -10 to 85 °C	-2.5	-	2	%
		V_{DDA} = 3.0 V, T_A = -10 to 105 °C	-4	-	2	%
		V_{DDA} = 1.65 V to 3.6 V T_A = -40 to 105 °C	-4	-	3	%
$t_{SU(HSI)}^{(2)}$	HSI oscillator startup time	-	-	3.7	6	µs
$I_{DD(HSI)}^{(2)}$	HSI oscillator power consumption	-	-	100	140	µA

1. The trimming step differs depending on the trimming code. It is usually negative on the codes which are multiples of 16 (0x00, 0x10, 0x20, 0x30...0xE0).
2. Guaranteed by characterization results.
3. Guaranteed by test in production.

Low-speed internal (LSI) RC oscillator

Table 31. LSI oscillator characteristics

Symbol	Parameter	Min	Typ	Max	Unit
$f_{LSI}^{(1)}$	LSI frequency	26	38	56	kHz
$D_{LSI}^{(2)}$	LSI oscillator frequency drift 0°C ≤T_A ≤105°C	-10	-	4	%
$t_{su(LSI)}^{(3)}$	LSI oscillator startup time	-	-	200	µs
$I_{DD(LSI)}^{(3)}$	LSI oscillator power consumption	-	400	510	nA

1. Guaranteed by test in production.
2. This is a deviation for an individual part, once the initial frequency has been measured.
3. Guaranteed by design.

Input/output AC characteristics

The definition and values of input/output AC characteristics are given in *Figure 26* and *Table 52*, respectively.

Unless otherwise specified, the parameters given in *Table 52* are derived from tests performed under the conditions summarized in *Table 13*.

Table 52. I/O AC characteristics(1)

OSPEEDRx [1:0] bit value(1)	Symbol	Parameter	Conditions	Min	Max(2)	Unit
00	$f_{max(IO)out}$	Maximum frequency(3)	C_L = 50 pF, V_{DD} = 2.7 V to 3.6 V	-	400	kHz
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	400	
	$t_{f(IO)out}$ $t_{r(IO)out}$	Output rise and fall time	C_L = 50 pF, V_{DD} = 2.7 V to 3.6 V	-	625	ns
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	625	
01	$f_{max(IO)out}$	Maximum frequency(3)	C_L = 50 pF, V_{DD} = 2.7 V to 3.6 V	-	2	MHz
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	1	
	$t_{f(IO)out}$ $t_{r(IO)out}$	Output rise and fall time	C_L = 50 pF, V_{DD} = 2.7 V to 3.6 V	-	125	ns
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	250	
10	$F_{max(IO)out}$	Maximum frequency(3)	C_L = 50 pF, V_{DD} = 2.7 V to 3.6 V	-	10	MHz
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	2	
	$t_{f(IO)out}$ $t_{r(IO)out}$	Output rise and fall time	C_L = 50 pF, V_{DD} = 2.7 V to 3.6 V	-	25	ns
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	125	
11	$F_{max(IO)out}$	Maximum frequency(3)	C_L = 30 pF, V_{DD} = 2.7 V to 3.6 V	-	50	MHz
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	8	
	$t_{f(IO)out}$ $t_{r(IO)out}$	Output rise and fall time	C_L = 30 pF, V_{DD} = 2.7 V to 3.6 V	-	5	ns
			C_L = 50 pF, V_{DD} = 1.65 V to 2.7 V	-	30	
-	t_{EXTIpw}	Pulse width of external signals detected by the EXTI controller	-	8	-	

1. The I/O speed is configured using the OSPEEDRx[1:0] bits. Refer to the STM32L151xx, STM32L152xx and STM32L162xx reference manual for a description of GPIO Port configuration register.
2. Guaranteed by design.
3. The maximum frequency is defined in *Figure 26*.

6.3.20 DAC electrical specifications

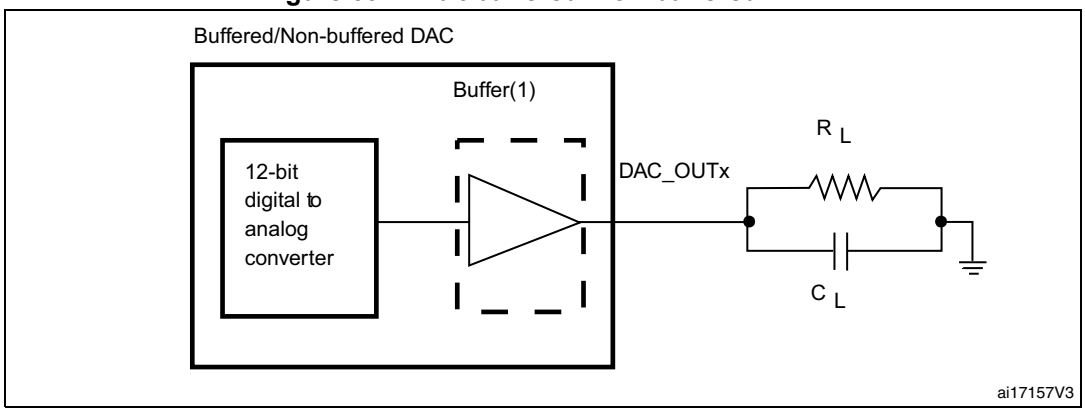
Data guaranteed by design, unless otherwise specified.

Table 67. DAC characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DDA}	Analog supply voltage	-	1.8	-	3.6	V
V_{REF+}	Reference supply voltage	V_{REF+} must always be below V_{DDA}	1.8	-	3.6	
V_{REF-}	Lower reference voltage	-	V_{SSA}			
$I_{DDVREF+}$(1)	Current consumption on V_{REF+} supply V_{REF+} = 3.3 V	No load, middle code (0x800)	-	130	220	µA
		No load, worst code (0x000)	-	220	350	
I_{DDA}(1)	Current consumption on V_{DDA} supply V_{DDA} = 3.3 V	No load, middle code (0x800)	-	210	320	
		No load, worst code (0xF1C)	-	320	520	
R_L(2)	Resistive load	DAC output buffer ON	5	-	-	kΩ
C_L(2)	Capacitive load		-	-	50	pF
R_O	Output impedance	DAC output buffer OFF	12	16	20	kΩ
V_{DAC_OUT}	Voltage on DAC_OUT output	DAC output buffer ON	0.2	-	V_{DDA} – 0.2	V
		DAC output buffer OFF	0.5	-	V_{REF+} – 1LSB	mV
DNL(1)	Differential non linearity(3)	$C_L \leq 50$ pF, $R_L \geq 5$ kΩ DAC output buffer ON	-	1.5	3	LSB
		No R_L, $C_L \leq 50$ pF DAC output buffer OFF	-	1.5	3	
INL(1)	Integral non linearity(4)	$C_L \leq 50$ pF, $R_L \geq 5$ kΩ DAC output buffer ON	-	2	4	
		No R_L, $C_L \leq 50$ pF DAC output buffer OFF	-	2	4	
Offset(1)	Offset error at code 0x800 (5)	$C_L \leq 50$ pF, $R_L \geq 5$ kΩ DAC output buffer ON	-	±10	±25	
		No R_L, $C_L \leq 50$ pF DAC output buffer OFF	-	±5	±8	
Offset1(1)	Offset error at code 0x001(6)	No R_L, $C_L \leq 50$ pF DAC output buffer OFF	-	±1.5	±5	

4. Difference between measured value at Code i and the value at Code i on a line drawn between Code 0 and last Code 4095.
5. Difference between the value measured at Code (0x800) and the ideal value = V_{REF+}/2.
6. Difference between the value measured at Code (0x001) and the ideal value.
7. Difference between ideal slope of the transfer function and measured slope computed from code 0x000 and 0xFFF when buffer is OFF, and from code giving 0.2 V and (V_{DDA} – 0.2) V when buffer is ON.
8. In buffered mode, the output can overshoot above the final value for low input code (starting from min value).

Figure 39. 12-bit buffered /non-buffered DAC



1. The DAC integrates an output buffer that can be used to reduce the output impedance and to drive external loads directly without the use of an external operational amplifier. The buffer can be bypassed by configuring the BOFFx bit in the DAC_CR register.

6.3.21 Operational amplifier characteristics

Table 68. Operational amplifier characteristics

Symbol	Parameter		Condition(1)	Min(2)	Typ	Max(2)	Unit
CMIR	Common mode input range		-	0	-	V_{DD}	
VI_{OFFSET}	Input offset voltage	Maximum calibration range	-	-	-	±15	mV
		After offset calibration	-	-	-	±1.5	
ΔVI_{OFFSET}	Input offset voltage drift	Normal mode	-	-	-	±40	µV/°C
		Low-power mode	-	-	-	±80	
I_{IB}	Input current bias	Dedicated input	75 °C	-	-	1	nA
		General purpose input		-	-	10	
I_{LOAD}	Drive current	Normal mode	-	-	-	500	µA
		Low-power mode	-	-	-	100	
I_{DD}	Consumption	Normal mode	No load, quiescent mode	-	100	220	µA
		Low-power mode		-	30	60	
CMRR	Common mode rejection ration	Normal mode	-	-	-85	-	dB
		Low-power mode	-	-	-90	-	

6.3.24 LCD controller

The device embeds a built-in step-up converter to provide a constant LCD reference voltage independently from the V_{DD} voltage. An external capacitor C_{ext} must be connected to the V_{LCD} pin to decouple this converter.

Table 73. LCD controller characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{LCD}	LCD external voltage	-	-	3.6	V
V_{LCD0}	LCD internal reference voltage 0	-	2.6	-	
V_{LCD1}	LCD internal reference voltage 1	-	2.73	-	
V_{LCD2}	LCD internal reference voltage 2	-	2.86	-	
V_{LCD3}	LCD internal reference voltage 3	-	2.98	-	
V_{LCD4}	LCD internal reference voltage 4	-	3.12	-	
V_{LCD5}	LCD internal reference voltage 5	-	3.26	-	
V_{LCD6}	LCD internal reference voltage 6	-	3.4	-	
V_{LCD7}	LCD internal reference voltage 7	-	3.55	-	
C_{ext}	V_{LCD} external capacitance	0.1	-	2	µF
I_{LCD}(1)	Supply current at V_{DD} = 2.2 V	-	3.3	-	µA
	Supply current at V_{DD} = 3.0 V	-	3.1	-	
R_{Htot}(2)	Low drive resistive network overall value	5.28	6.6	7.92	MΩ
R_L(2)	High drive resistive network total value	192	240	288	kΩ
V_{44}	Segment/Common highest level voltage	-	-	V_{LCD}	V
V_{34}	Segment/Common 3/4 level voltage	-	3/4 V_{LCD}	-	V
V_{23}	Segment/Common 2/3 level voltage	-	2/3 V_{LCD}	-	
V_{12}	Segment/Common 1/2 level voltage	-	1/2 V_{LCD}	-	
V_{13}	Segment/Common 1/3 level voltage	-	1/3 V_{LCD}	-	
V_{14}	Segment/Common 1/4 level voltage	-	1/4 V_{LCD}	-	
V_0	Segment/Common lowest level voltage	0	-	-	
ΔVxx(3)	Segment/Common level voltage error T_A = -40 to 105 °C	-	-	±50	mV

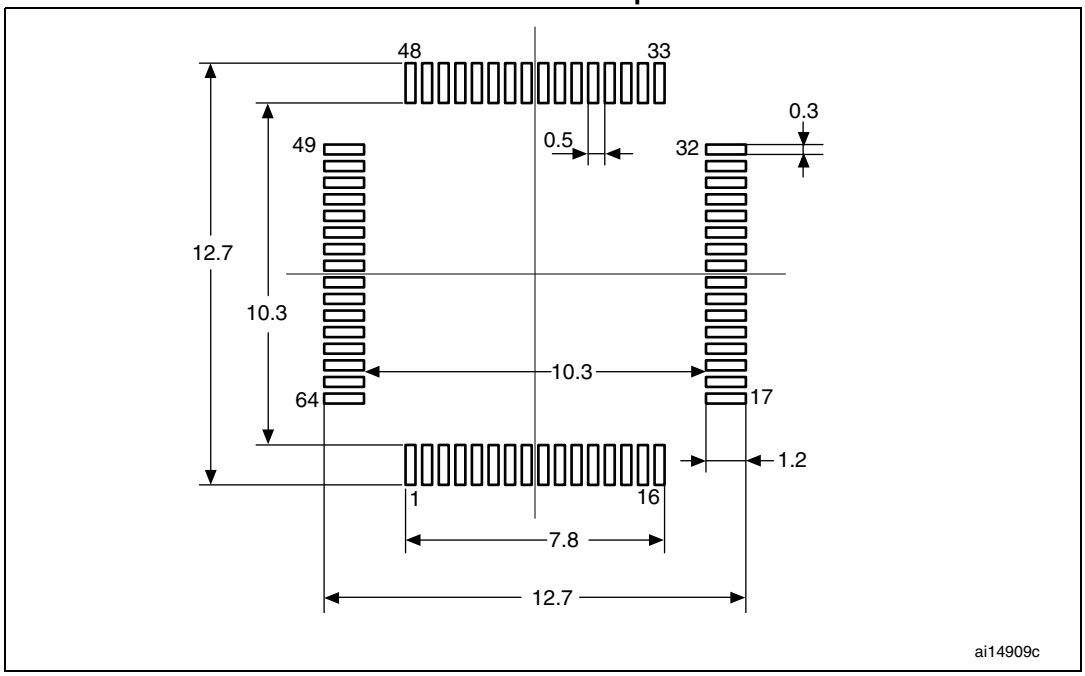
1. LCD enabled with 3 V internal step-up active, 1/8 duty, 1/4 bias, division ratio= 64, all pixels active, no LCD connected.
2. Guaranteed by design.
3. Guaranteed by characterization results.

Table 76. LQFP64, 10 x 10 mm 64-pin 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	-
K	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 47. LQFP64, 10 x 10 mm, 64-pin low-profile quad flat package recommended footprint



1. Dimensions are in millimeters.

9 Revision History

Table 82. Document revision history

Date	Revision	Changes
03-Oct-2011	1	Initial release.
03-Feb-2012	2	Status of the document changed (datasheet instead of preliminary data). Updated low power features on page 1. Removed references to devices with 256 KB of Flash memory. GPIOF replaced with GIOPH. Added SDIO in *Table 4: Ultra-low-power STM32L15xxD device features and peripheral counts on page 12* and in *Table 19: ction input/output on page 86* (FSMC/SDIO instead of FSMC). *Table 4: Ultra-low-power STM32L15xxD device features and peripheral counts*: replaced STM32L15xWx with STM32L15xQx. *Figure 1: Ultra-low-power STM32L162xC block diagram*: updated legend. Modified *Section 3.4: Clock management on page 20*. *Table 4: STM32L15xQD STM32L162QD UFBGA132 ballout*: replaced STM32L15xWC/D with STM32L15xQD. *Figure 3*, *Figure 3*, *Figure 4*: updated titles. *Table 14: STM32L15xxD pin definitions*: updated title, updated pins PF0, PF1, PH2, PF12, PF13, PF14, PF15, PG0, PG1, PG12, PG15, PD0, and PD1. *Table 19: ction input/output*: Modified ction for PA13 and PA14; removed EVENT OUT for PH2. *Figure 5: Memory map*: removed the text “APB memory space”. Modified *Figure 8: Power supply scheme on page 46*. Modified *Table 2: Functionalities depending on the operating power supply range on page 15*. *Table 18: Current consumption in Run mode, code with data processing running from RAM*: added footnote *3*. *Table 19: Current consumption in Sleep mode*: updated condition for f_{HSE}; added footnote *3*. *Table 23: Typical and maximum current consumptions in Standby mode*: modified max values. *Table 64: USB DC electrical characteristics*: removed two footnotes. Modified *Table 38: Flash memory and data EEPROM characteristics on page 83*. *Table 73: Thermal characteristics*: updated “TBDs” with values. Modified tables in *Section 6.3.4: Supply current characteristics on page 54*.

Table 82. Document revision history (continued)

Date	Revision	Changes
18-Apr-2012	3	Added WLCSP64 package. *Section 3: Functional overview*: changed '128 kHz' to '131 kHz' in section "Low power run mode". *Section 3.17.1: General-purpose timers (TIM2, TIM3, TIM4, TIM5, TIM9, TIM10 and TIM11)*: changed 'six' to 'seven' synchronizable general-purpose timers. *Table 14: STM32L15xxD pin definitions on page 52*: updated name of reference manual in footnote *5.* I2C updated: footnote *3.* from *Table 58* Note about I2C clock updated: footnote *2.* from *Table 58* modified. Note [non-robust] updated: footnote *2.* from *Table 68* modified. GPIOs high current capability updated: *Section 3.6: GPIOs (general-purpose inputs/outputs)* 'except for analog inputs' was removed.
15-Jun-2012	4	Changed maximum number of touch sensing channels to 34, and updated *Table 4: Ultra-low-power STM32L15xxD device features and peripheral counts*. Updated *Section 3.10: ADC (analog-to-digital converter)* to add *Section 3.10.1: Temperature sensor* and *Section 3.10.2: Internal voltage reference (VREFINT)*. Removed caution note below *Figure 8: Power supply scheme*. Added note below *Table 4: STM32L15xQD STM32L162QD UFBGA132 ballout*. Modified *Table 8: STM32L15xRDSTM32L162RD WLCSP64 ballout* to match top view. Changed FSMC_LBAR into FSMC_NADV, and I2C1_SMBAI into I2C1_SMBA in *Table 14: STM32L15xxD pin definitions*. Modified PB10/11/12 for AFIO4 ction, and replaced LBAR by NADV for AFIO12 in *Table 19: ction input/output*. Updated *Table 22: Typical and maximum current consumptions in Stop mode* and added *Note 6*. Updated *Table 23: Typical and maximum current consumptions in Standby mode*. Updated t_{WUSTOP} in *Table :* . Updated *Table 27: Peripheral current consumption*. Updated *Table 60: SPI characteristics*, added *Note 1* and *Note 3*, and applied *Note 2* to $t_{r(SCK)}$, $t_{f(SCK)}$, $t_{w(SCKH)}$, $t_{w(SCKL)}$, $t_{su(MI)}$, $t_{su(SI)}$, $t_{h(MI)}$, and $t_{h(SI)}$. Updated I_{DD} maximum value in *Table 38: Flash memory and data EEPROM characteristics*.

Table 82. Document revision history (continued)

Date	Revision	Changes
25-Oct-2012	5	Updated Features Updated *Figure 1: Ultra-low-power STM32L162xC block diagram* Added *Table 4: Functionalities depending on the working mode (from Run/active down to standby)*, and *Table 3: ange depending on dynamic voltage scaling* Updated *Figure 3: STM32L162VC LQFP100 pinout* Updated *Table 14: STM32L15xxD pin definitions* Added *Note 2* in *Table 15: Embedded reset and power control block characteristics* Replaced TBD values in *Table 30: Low-speed external user clock characteristics*, *Table 38: Flash memory and data EEPROM characteristics* and *Table 55: I/O AC characteristics* Added *Table 61: I2S characteristics*, *Figure 29: I2S slave timing diagram (Philips protocol)(1)* and *Figure 30: I2S master timing diagram (Philips protocol)(1)* Added *Table 62: SDIO characteristics* Added *Figure 31: SDIO timings* Updated *Section 6.3.9: FSMC characteristics* Updated *Table 72: Temperature sensor characteristics* Added *Figure 40: Thermal resistance*
01-Feb-2013	6	Removed AHB1/AHB2 and corrected typo on APB1/APB2 in *Figure 1: Ultra-low-power STM32L162xC block diagram* Updated “OP amp” line in *Table 4: Functionalities depending on the working mode (from Run/active down to standby)* Added IWDG and WWDG rows in *Table 4: Functionalities depending on the working mode (from Run/active down to standby)* Added OneNAND support in *Section 3.8: FSMC (flexible static memory controller)* The comment "HSE = 16 MHz(2) (PLL ON for fHCLK above 16 MHz)" replaced by "fHSE = fHCLK up to 16 MHz included, fHSE = fHCLK/2 above 16 MHz (PLL ON)(2)” in table *Table 19: Current consumption in Sleep mode* Updated Stop mode current to 1.5 µA in *Ultra low power platform* Replaced BGA132 by UFBGA132 in *Table 4: Ultra-low-power STM32L15xxD device features and peripheral counts* Replaced BGA132 by UFBGA132 in *Figure 4: STM32L15xQD STM32L162QD UFBGA132 ballout* Updated entire *Section 7: Package characteristics*