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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M0
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	I²C, SPI, UART/USART, USB
Peripherals	DMA, POR, PWM, WDT
Number of I/O	51
Program Memory Size	128KB (128K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	2.4V ~ 3.6V
Data Converters	A/D 16x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-LQFP
Supplier Device Package	64-LQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/stmicroelectronics/stm32f070rbt6tr

List of tables

1 Introduction

This datasheet provides the ordering information and mechanical device characteristics of the STM32F070CB/RB/C6/F6 microcontrollers.

This document should be read in conjunction with the STM32F0x0xx reference manual (RM0360). The reference manual is available from the STMicroelectronics website *www.st.com*.

For information on the ARM® Cortex®-M0 core, please refer to the Cortex®-M0 Technical Reference Manual, available from the www.arm.com website.

4 Pinouts and pin descriptions

Figure 3. LQFP64 64-pin package pinout (top view)

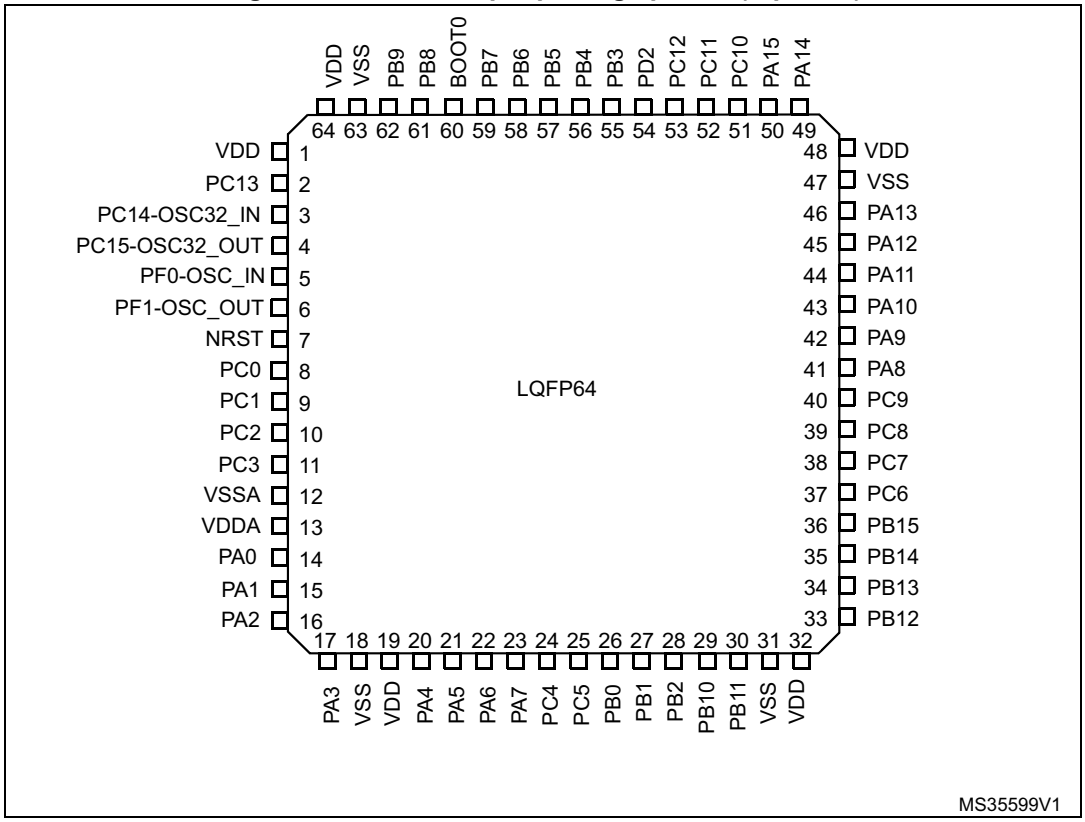


Figure 4. LQFP48 48-pin package pinout (top view)

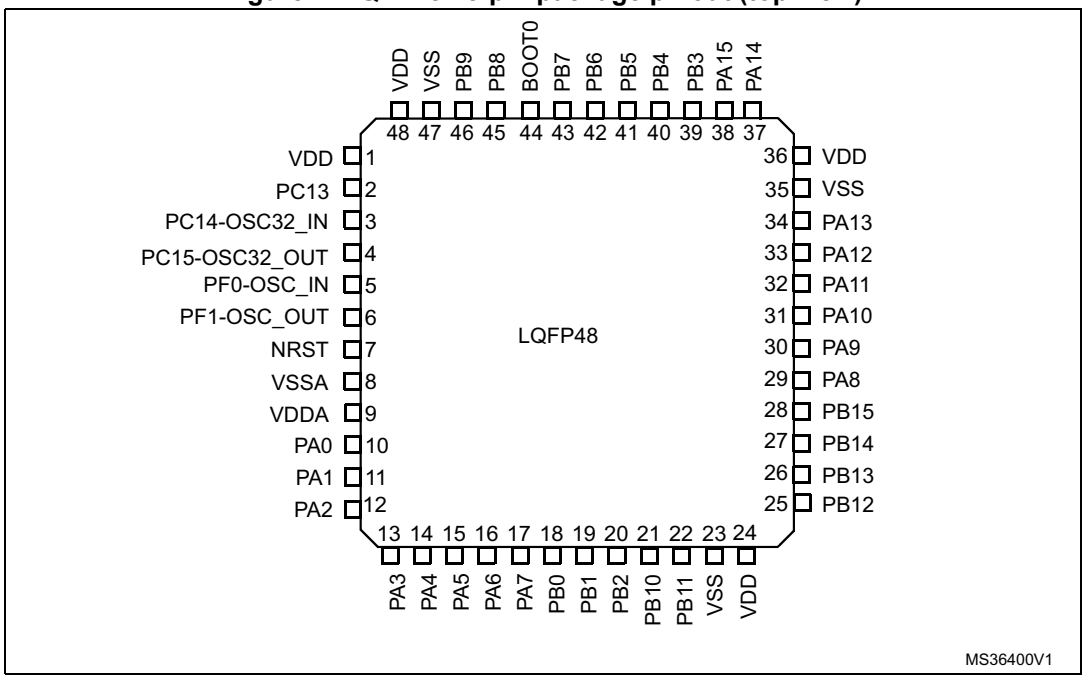


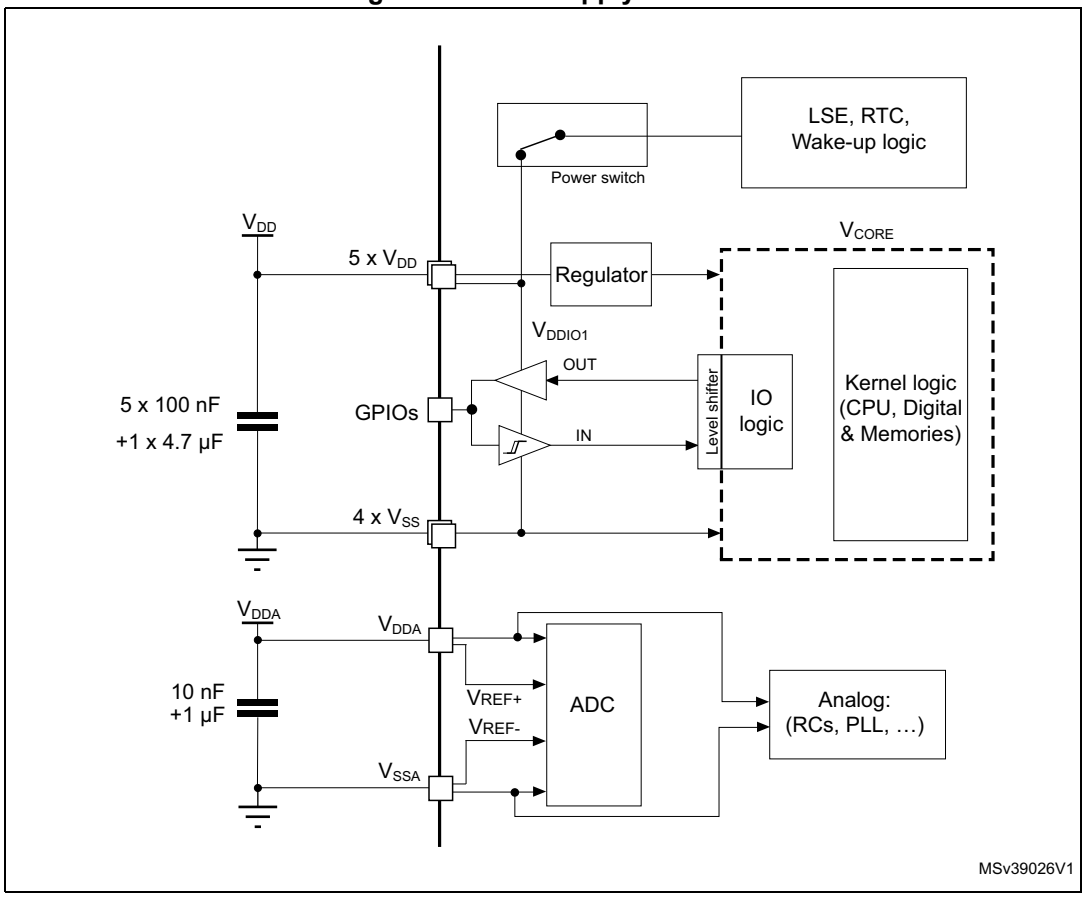
Table 10. STM32F070xB/6 pin definitions (continued)

Pin numbers			Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP64	LQFP48	TSSOP20					Alternate functions	Additional functions
59	43	-	PB7	I/O	FTf	(4)	I2C1_SDA, USART1_RX, USART4_CTS, TIM17_CH1N	-
60	44	1	BOOT0	I	B	-	Boot memory selection	
61	45	-	PB8	I/O	FTf	-	I2C1_SCL, TIM16_CH1	-
62	46	-	PB9	I/O	FTf	(4)	SPI2_NSS, I2C1_SDA, IR_OUT, TIM17_CH1, EVENTOUT	-
63	47	-	VSS	S	-	-	Ground	
64	48	-	VDD	S	-	-	Digital power supply	

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 the first RTC domain power-up, PC13, PC14 and PC15 operate as GPIOs. Their function then depends on 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 RTC domain and RTC register descriptions in the reference manual.
3. Available on STM32F070C6/F6 devices only.
4. TIM15, I2C2, WKUP4, WKUP5, WKUP6, WKUP7, SPI2, USART3 and USART4 are available on STM32F070CB/RB devices only.
5. On STM32F070C6/F6 devices, pin pair PA11/12 can be remapped instead of pin pair PA9/10 using SYSCFG_CFGR1 register.
6. After reset, these pins are configured as SWDIO and SWCLK alternate functions, and the internal pull-up on the SWDIO pin and the internal pull-down on the SWCLK pin are activated.

6.1.6 Power supply scheme

Figure 9. Power supply scheme



Caution: Each power supply pair (V_{DD}/V_{SS}, V_{DDA}/V_{SSA} etc.) must be decoupled with filtering ceramic capacitors as shown above. These capacitors must be placed as close as possible to, or below, the appropriate pins on the underside of the PCB to ensure the good functionality of the device.

Table 18. Current characteristics

Symbol	Ratings	Max.	Unit
ΣI_{VDD}	Total current into sum of all VDD power lines (source)(1)	120	mA
ΣI_{VSS}	Total current out of sum of all VSS ground lines (sink)(1)	-120	
$I_{VDD(PIN)}$	Maximum current into each VDD power pin (source)(1)	100	
$I_{VSS(PIN)}$	Maximum current out of each VSS ground pin (sink)(1)	-100	
$I_{IO(PIN)}$	Output current sunk by any I/O and control pin	25	
	Output current source by any I/O and control pin	-25	
$\Sigma I_{IO(PIN)}$	Total output current sunk by sum of all I/Os and control pins(2)	80	
	Total output current sourced by sum of all I/Os and control pins(2)	-80	
$I_{INJ(PIN)}$(3)	Injected current on FT and FTf pins	-5/+0(4)	
	Injected current on TC and RST pin	± 5	
	Injected current on TTa pins(5)	± 5	
$\Sigma I_{INJ(PIN)}$	Total injected current (sum of all I/O and control pins)(6)	± 25	

1. All main power (VDD, VDDA) and ground (VSS, VSSA) pins must always be connected to the external power supply, in the permitted range.
2. This current consumption must be correctly distributed over all I/Os and control pins. The total output current must not be sunk/sourced between two consecutive power supply pins referring to high pin count QFP packages.
3. A positive injection is induced by $V_{IN} > V_{DDIOx}$ while a negative injection is induced by $V_{IN} < V_{SS}$. $I_{INJ(PIN)}$ must never be exceeded. Refer to *Table 17: Voltage characteristics* for the maximum allowed input voltage values.
4. Positive injection is not possible on these I/Os and does not occur for input voltages lower than the specified maximum value.
5. On these I/Os, a positive injection is induced by $V_{IN} > V_{DDA}$. Negative injection disturbs the analog performance of the device. See note (2) below *Table 51: ADC accuracy*.
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 19. 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 20. General operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
f_{HCLK}	Internal AHB clock frequency	-	0	48	MHz
f_{PCLK}	Internal APB clock frequency	-	0	48	
V_{DD}	Standard operating voltage	-	2.4	3.6	V

Table 22. Embedded reset and power control block characteristics (continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{PDRhyst}$	PDR hysteresis	-	-	40	-	mV
$t_{RSTTEMPO}$ (4)	Reset temporization	-	1.50	2.50	4.50	ms

1. The PDR detector monitors V_{DD} and also V_{DDA} (if kept enabled in the option bytes). The POR detector monitors only V_{DD}.
2. The product behavior is guaranteed by design down to the minimum $V_{POR/PDR}$ value.
3. Data based on characterization results, not tested in production.
4. Guaranteed by design, not tested in production.

6.3.4 Embedded reference voltage

The parameters given in *Table 23* are derived from tests performed under the ambient temperature and supply voltage conditions summarized in *Table 20: General operating conditions*.

Table 23. Embedded internal reference voltage

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{REFINT}	Internal reference voltage	-40°C < T_A < +85°C	1.2	1.23	1.25	V
t_{START}	ADC_IN17 buffer startup time	-	-	-	10 (1)	µs
$t_{S\_vrefint}$	ADC sampling time when reading the internal reference voltage	-	4 (1)	-	-	µs
ΔV_{REFINT}	Internal reference voltage spread over the temperature range	V_{DDA} = 3 V	-	-	10 (1)	mV
T_{Coeff}	Temperature coefficient	-	-100 (1)	-	100 (1)	ppm/°C

1. Guaranteed by design, not tested in production.

6.3.5 Supply current characteristics

The current consumption is a function of several parameters and factors such as the operating voltage, ambient temperature, I/O pin loading, device software configuration, operating frequencies, I/O pin switching rate, program location in memory and executed binary code.

The current consumption is measured as described in *Figure 10: Current consumption measurement scheme*.

All Run-mode current consumption measurements given in this section are performed with a reduced code that gives a consumption equivalent to CoreMark code.

1. Current consumption from the V_{DDA} supply is independent of whether the digital peripherals are enabled or disabled, being in Run or Sleep mode or executing from Flash or RAM. Furthermore, when the PLL is off, I_{DDA} is independent from the frequency.

Table 26. Typical and maximum consumption in Stop and Standby modes

Symbol	Parameter	Conditions		Typ @V_{DD} (V_{DD} = V_{DDA})	Max(1)	Unit
				3.6 V	T_A = 85 °C	
I_{DD}	Supply current in Stop mode	Regulator in run mode, all oscillators OFF		15.9	49	µA
		Regulator in low-power mode, all oscillators OFF		3.7	33	
	Supply current in Standby mode	LSI ON and IWDG ON		1.5	-	
I_{DDA}	Supply current in Stop mode	V_{DDA} monitoring ON	Regulator in run or low-power mode, all oscillators OFF	2.8	3.6	
	Supply current in Standby mode		LSI ON and IWDG ON	3.5	-	
			LSI OFF and IWDG OFF	2.6	3.6	
	Supply current in Stop mode	V_{DDA} monitoring OFF	Regulator in run or low-power mode, all oscillators OFF	1.5	-	
	Supply current in Standby mode		LSI ON and IWDG ON	2.2	-	
			LSI OFF and IWDG OFF	1.4	-	

1. Data based on characterization results, not tested in production unless otherwise specified.

Typical current consumption

The MCU is placed under the following conditions:

- V_{DD} = V_{DDA} = 3.3 V
- All I/O pins are in analog input configuration
- The Flash access time is adjusted to f_{HCLK} frequency:
  - 0 wait state and Prefetch OFF from 0 to 24 MHz
  - 1 wait state and Prefetch ON above 24 MHz
- When the peripherals are enabled, f_{PCLK} = f_{HCLK}
- PLL is used for frequencies greater than 8 MHz
- AHB prescaler of 2, 4, 8 and 16 is used for the frequencies 4 MHz, 2 MHz, 1 MHz and 500 kHz respectively

Table 32. HSE oscillator characteristics

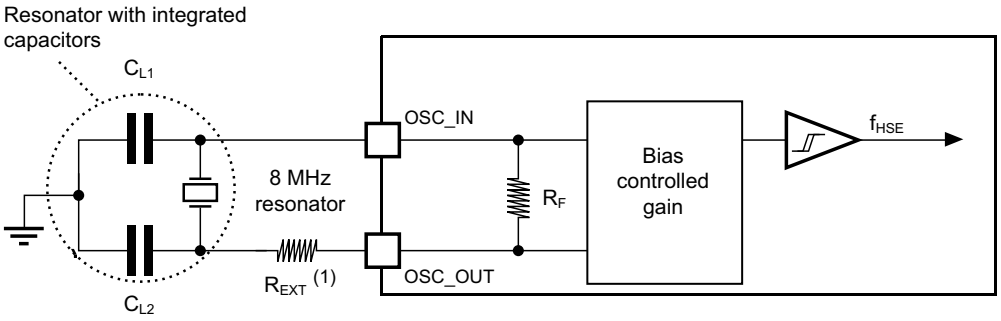
Symbol	Parameter	Conditions[1]	Min[2]	Typ	Max[2]	Unit
I_{DD}	HSE current consumption	During startup[3]	-	-	8.5	mA
		V_{DD} = 3.3 V, Rm = 45 Ω, CL = 10 pF@8 MHz	-	0.5	-	
		V_{DD} = 3.3 V, Rm = 30 Ω, CL = 20 pF@32 MHz	-	1.5	-	
g_m	Oscillator transconductance	Startup	10	-	-	mA/V
$t_{SU(HSE)}$[4]	Startup time	V_{DD} is stabilized	-	2	-	ms

1. Resonator characteristics given by the crystal/ceramic resonator manufacturer.
2. Guaranteed by design, not tested in production.
3. This consumption level occurs during the first 2/3 of the $t_{SU(HSE)}$ startup time
4. $t_{SU(HSE)}$ is the startup time measured from the moment it is enabled (by software) to a stabilized 8 MHz oscillation is reached. This value is measured for a standard crystal resonator and it can vary significantly with the crystal manufacturer

For C_{L1} and C_{L2}, it is recommended to use high-quality external ceramic capacitors in the 5 pF to 20 pF range (Typ.), designed for high-frequency applications, and selected to match the requirements of the crystal or resonator (see *Figure 13*). C_{L1} and C_{L2} are usually the same size. The crystal manufacturer typically specifies a load capacitance which is the series combination of C_{L1} and C_{L2}. PCB and MCU pin capacitance must be included (10 pF can be used as a rough estimate of the combined pin and board capacitance) when sizing C_{L1} and C_{L2}.

Note: For information on selecting the crystal, refer to the application note AN2867 "Oscillator design guide for ST microcontrollers" available from the ST website www.st.com.

Figure 13. Typical application with an 8 MHz crystal



1. R_{EXT} value depends on the crystal characteristics.

Low-speed external clock generated from a crystal resonator

The low-speed external (LSE) clock can be supplied with a 32.768 kHz crystal resonator oscillator. All the information given in this paragraph are based on design simulation results

6.3.8 Internal clock source characteristics

The parameters given in *Table 34* are derived from tests performed under ambient temperature and supply voltage conditions summarized in *Table 20: General operating conditions*. The provided curves are characterization results, not tested in production.

High-speed internal (HSI) RC oscillator

Table 34. HSI oscillator characteristics(1)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{HSI}	Frequency	-	-	8	-	MHz
TRIM	HSI user trimming step	-	-	-	1(2)	%
$DuCy_{HSI}$	Duty cycle	-	45(2)	-	55(2)	%
ACC_{HSI}	Accuracy of the HSI oscillator (factory calibrated)	T_A = -40 to 85°C	-	±5	-	%
		T_A = 25°C	-	±1(3)	-	%
$t_{SU(HSI)}$	HSI oscillator startup time	-	1(2)	-	2(2)	µs
$I_{DDA(HSI)}$	HSI oscillator power consumption	-	-	80	-	µA

1. V_{DDA} = 3.3 V, T_A = -40 to 85°C unless otherwise specified.
2. Guaranteed by design, not tested in production.
3. With user calibration.

High-speed internal 14 MHz (HSI14) RC oscillator (dedicated to ADC)

Table 35. HSI14 oscillator characteristics(1)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{HSI14}	Frequency	-	-	14	-	MHz
TRIM	HSI14 user-trimming step	-	-	-	1(2)	%
$DuCy_{(HSI14)}$	Duty cycle	-	45(2)	-	55(2)	%
ACC_{HSI14}	Accuracy of the HSI14 oscillator (factory calibrated)	T_A = –40 to 85 °C	-	±5	-	%
$t_{su(HSI14)}$	HSI14 oscillator startup time	-	1(2)	-	2(2)	µs
$I_{DDA(HSI14)}$	HSI14 oscillator power consumption	-	-	100	-	µA

1. V_{DDA} = 3.3 V, T_A = -40 to 85 °C unless otherwise specified.
2. Guaranteed by design, not tested in production.

Low-speed internal (LSI) RC oscillator

Table 36. LSI oscillator characteristics(1)

Symbol	Parameter	Min	Typ	Max	Unit
f_{LSI}	Frequency	30	40	50	kHz

Table 44. I/O current injection susceptibility

Symbol	Description	Functional susceptibility		Unit
		Negative injection	Positive injection	
I_{INJ}	Injected current on BOOT0 and PF1 pins	-0	NA	mA
	Injected current on PA9, PB3, PB13, PF11 pins with induced leakage current on adjacent pins less than 50 µA	-5	NA	
	Injected current on PA11 and PA12 pins with induced leakage current on adjacent pins less than -1 mA	-5	NA	
	Injected current on all other FT and FTf pins	-5	NA	
	Injected current on PB0 and PB1 pins	-5	NA	
	Injected current on PC0 pin	-0	+5	
	Injected current on all other TTa, TC and RST pins	-5	+5	

6.3.14 I/O port characteristics

General input/output characteristics

Unless otherwise specified, the parameters given in *Table 45* are derived from tests performed under the conditions summarized in *Table 20: General operating conditions*. All I/Os are designed as CMOS- and TTL-compliant (except BOOT0).

Table 45. I/O static characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IL}	Low level input voltage	TC and TTa I/O	-	-	$0.3\ V_{DDIOx}+0.07^{(1)}$	V
		FT and FTf I/O	-	-	$0.475\ V_{DDIOx}-0.2^{(1)}$	
		BOOT0	-	-	$0.3\ V_{DDIOx}-0.3^{(1)}$	
		All I/Os except BOOT0 pin	-	-	$0.3\ V_{DDIOx}$	
V_{IH}	High level input voltage	TC and TTa I/O	$0.445\ V_{DDIOx}+0.398^{(1)}$	-	-	V
		FT and FTf I/O	$0.5\ V_{DDIOx}+0.2^{(1)}$	-	-	
		BOOT0	$0.2\ V_{DDIOx}+0.95^{(1)}$	-	-	
		All I/Os except BOOT0 pin	$0.7\ V_{DDIOx}$	-	-	
V_{hys}	Schmitt trigger hysteresis	TC and TTa I/O	-	$200^{(1)}$	-	mV
		FT and FTf I/O	-	$100^{(1)}$	-	
		BOOT0	-	$300^{(1)}$	-	

Figure 15. TC and TTa I/O input characteristics

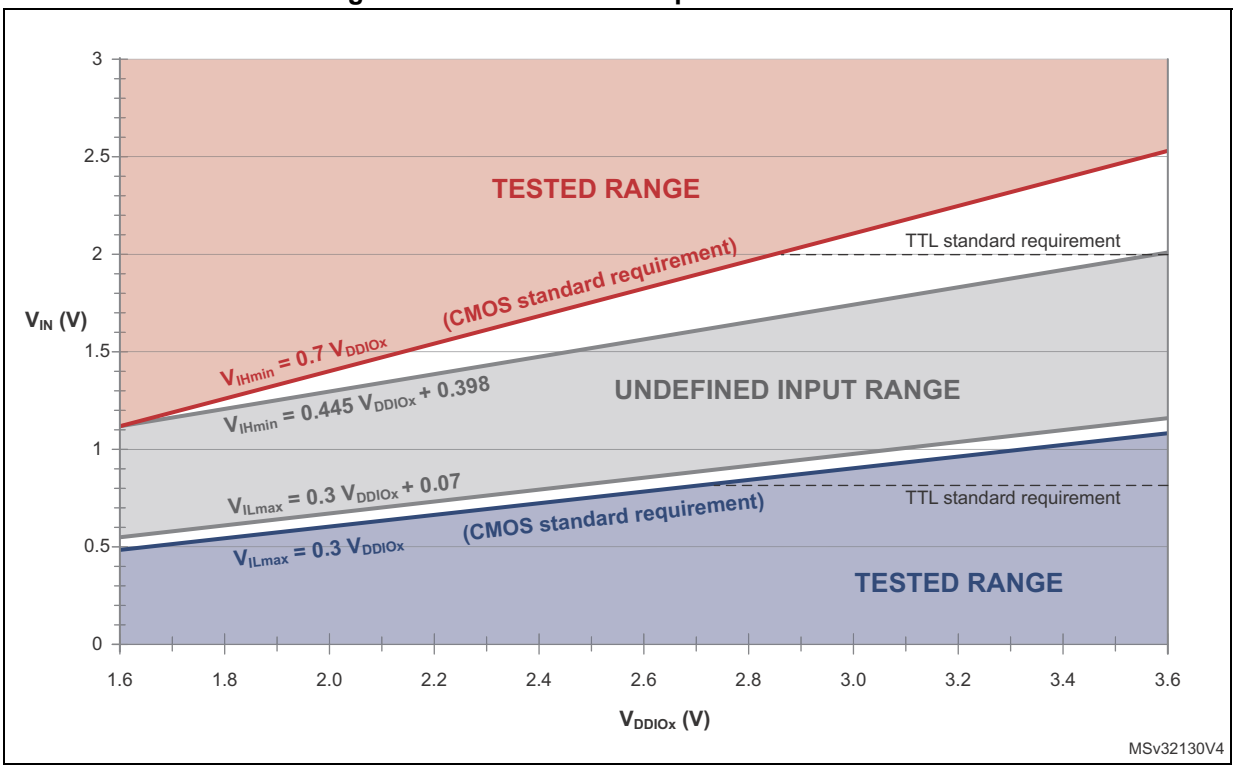


Figure 16. Five volt tolerant (FT and FTf) I/O input characteristics

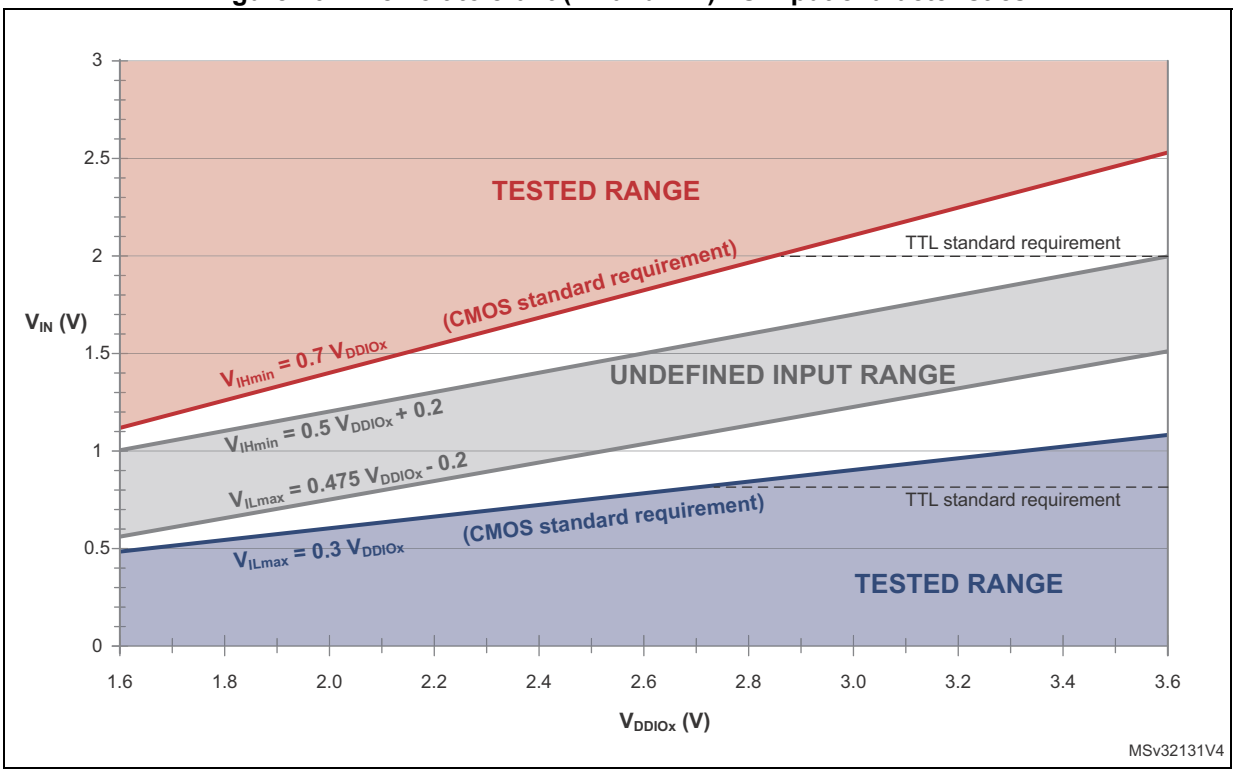


Table 47. I/O AC characteristics(1)(2)

OSPEEDRy [1:0] value(1)	Symbol	Parameter	Conditions	Min	Max	Unit
x0	$f_{max(IO)out}$	Maximum frequency(3)	C_L = 50 pF, $V_{DDIOx} \geq$ 2.4 V	-	2	MHz
	$t_{f(IO)out}$	Output fall time		-	125	ns
	$t_{r(IO)out}$	Output rise time		-	125	
01	$f_{max(IO)out}$	Maximum frequency(3)	C_L = 50 pF, $V_{DDIOx} \geq$ 2.4 V	-	10	MHz
	$t_{f(IO)out}$	Output fall time		-	25	ns
	$t_{r(IO)out}$	Output rise time		-	25	
11	$f_{max(IO)out}$	Maximum frequency(3)	C_L = 30 pF, $V_{DDIOx} \geq$ 2.7 V	-	50	MHz
			C_L = 50 pF, $V_{DDIOx} \geq$ 2.7 V	-	30	
			C_L = 50 pF, 2.4 V $\leq V_{DDIOx} <$ 2.7 V	-	20	
	$t_{f(IO)out}$	Output fall time	C_L = 30 pF, $V_{DDIOx} \geq$ 2.7 V	-	5	ns
			C_L = 50 pF, $V_{DDIOx} \geq$ 2.7 V	-	8	
			C_L = 50 pF, 2.4 V $\leq V_{DDIOx} <$ 2.7 V	-	12	
	$t_{r(IO)out}$	Output rise time	C_L = 30 pF, $V_{DDIOx} \geq$ 2.7 V	-	5	
			C_L = 50 pF, $V_{DDIOx} \geq$ 2.7 V	-	8	
			C_L = 50 pF, 2.4 V $\leq V_{DDIOx} <$ 2.7 V	-	12	
Fm+ configuration (4)	$f_{max(IO)out}$	Maximum frequency(3)	C_L = 50 pF, $V_{DDIOx} \geq$ 2.4 V	-	2	MHz
	$t_{f(IO)out}$	Output fall time		-	12	ns
	$t_{r(IO)out}$	Output rise time		-	34	
-	t_{EXTIpw}	Pulse width of external signals detected by the EXTI controller	-	10	-	ns

1. The I/O speed is configured using the OSPEEDRx[1:0] bits. Refer to the STM32F0xxxx RM0360 reference manual for a description of GPIO Port configuration register.
2. Guaranteed by design, not tested in production.
3. The maximum frequency is defined in *Figure 17*.
4. When Fm+ configuration is set, the I/O speed control is bypassed. Refer to the STM32F0xxxx reference manual RM0360 for a detailed description of Fm+ I/O configuration.

6.3.17 Temperature sensor characteristics

Table 52. TS characteristics

Symbol	Parameter	Min	Typ	Max	Unit
T_L (1)	V_{SENSE} linearity with temperature	-	±1	±2	°C
Avg_Slope(1)	Average slope	4.0	4.3	4.6	mV/°C
V_{30}	Voltage at 30 °C (±5 °C)(2)	1.34	1.43	1.52	V
t_{START} (1)	ADC_IN16 buffer startup time	-	-	10	µs
t_{S_temp} (1)	ADC sampling time when reading the temperature	4	-	-	µs

1. Guaranteed by design, not tested in production.
2. Measured at V_{DDA} = 3.3 V ± 10 mV. The V_{30} ADC conversion result is stored in the TS_CAL1 byte. Refer to *Table 2: Temperature sensor calibration values*.

6.3.18 Timer characteristics

The parameters given in the following tables are guaranteed by design.

Refer to *Section 6.3.14: I/O port characteristics* for details on the input/output alternate function characteristics (output compare, input capture, external clock, PWM output).

Table 53. TIMx characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{res(TIM)}$	Timer resolution	-	-	1	-	$t_{TIMxCLK}$
		$f_{TIMxCLK}$ = 48 MHz	-	20.8	-	ns
f_{EXT}	Timer external clock frequency on CH1 to CH4	-	-	$f_{TIMxCLK}/2$	-	MHz
		$f_{TIMxCLK}$ = 48 MHz	-	24	-	MHz
t_{MAX_COUNT}	16-bit timer maximum period	-	-	2^{16}	-	$t_{TIMxCLK}$
		$f_{TIMxCLK}$ = 48 MHz	-	1365	-	µs
	32-bit timer maximum period	-	-	2^{32}	-	$t_{TIMxCLK}$
		$f_{TIMxCLK}$ = 48 MHz	-	89.48	-	s

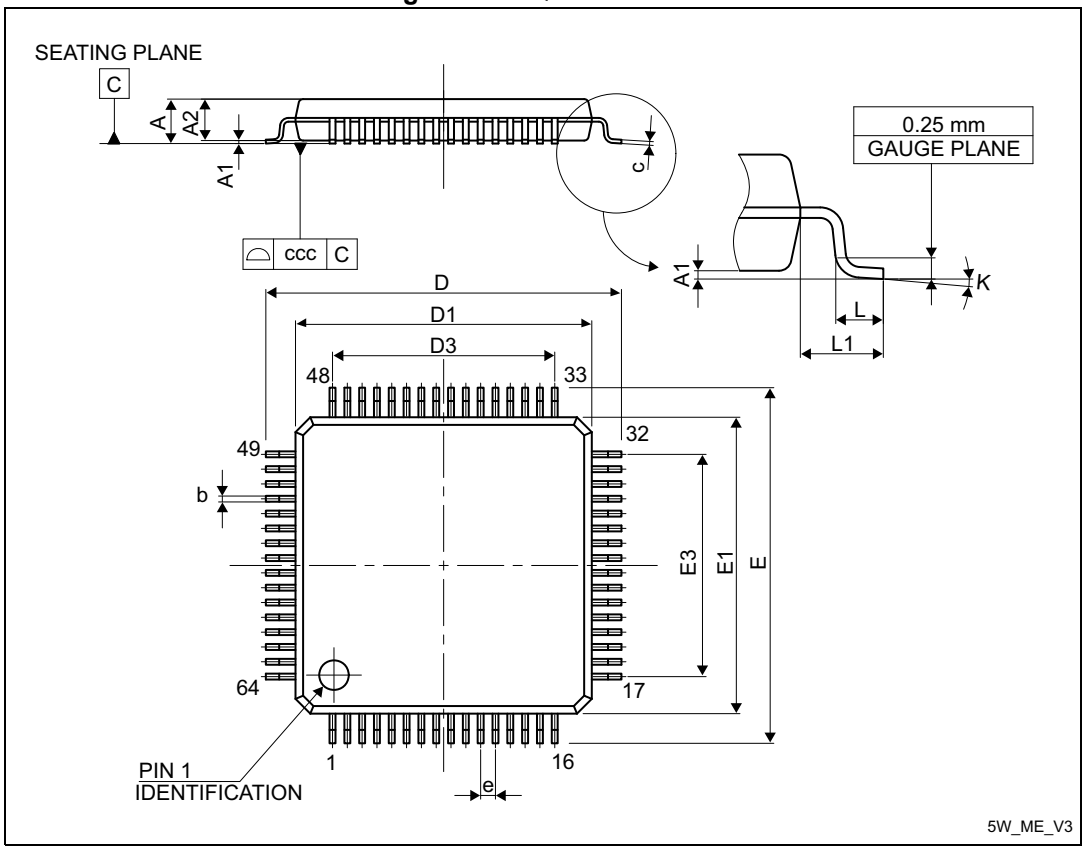
7 Package information

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.

7.1 LQFP64 package information

LQFP64 is 64-pin, 10 x 10 mm low-profile quad flat package.

Figure 24. LQFP64 outline



1. Drawing is not to scale.

Table 59. LQFP64 mechanical data

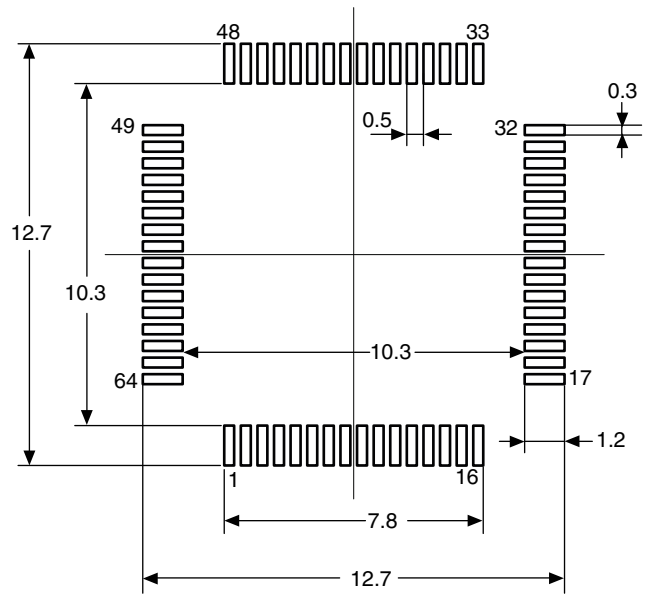
Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	-	-	1.600	-	-	0.0630
A1	0.050	-	0.150	0.0020	-	0.0059
A2	1.350	1.400	1.450	0.0531	0.0551	0.0571

Table 59. LQFP64 mechanical data (continued)

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
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	-
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 25. LQFP64 recommended footprint



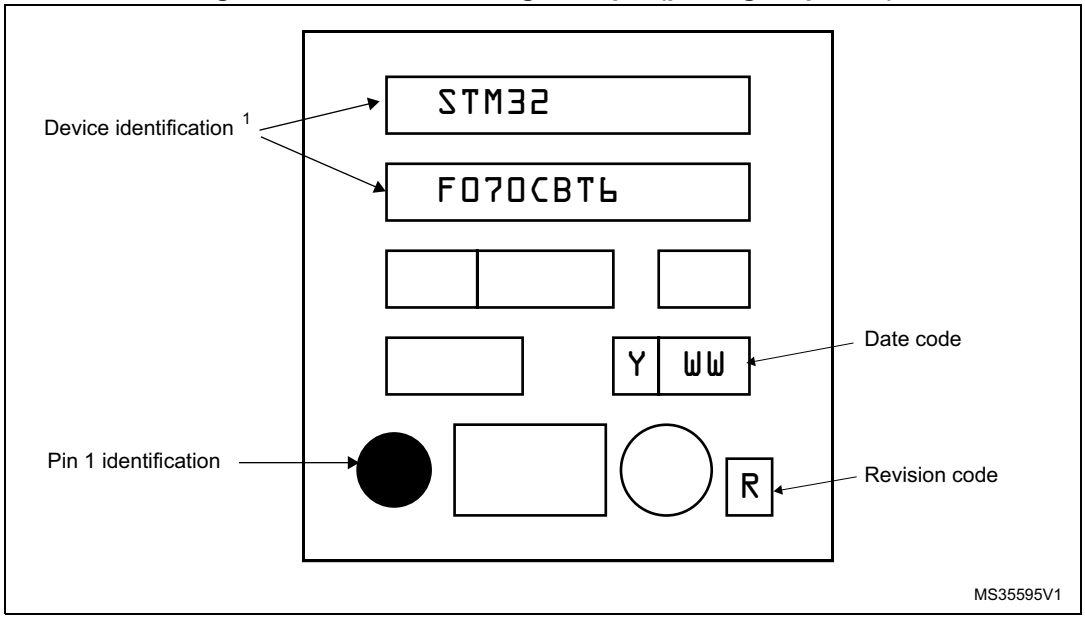
1. Dimensions are expressed in millimeters.

Device marking

The following figure gives an example of topside marking orientation versus pin 1 identifier location.

Other optional marking or inset/upset marks, which identify the parts throughout supply chain operations, are not indicated below.

Figure 29. LQFP48 marking example (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.

Table 64. Document revision history (continued)

Date	Revision	Changes
07-Feb-2016	3	– *Figure 15* and *Figure 16* improved – *Section 7: Package information* name and structure *change* – *Section 8: Ordering information* renamed from Part numbering; removed undue code sizes