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What is "Embedded - Microcontrollers"?

"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®-M0
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	DMA, I²S, POR, PWM, WDT
Number of I/O	20
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 3.6V
Data Converters	A/D 13x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	25-UFBGA, WLCSP
Supplier Device Package	25-WLCSP
Purchase URL	https://www.e-xfl.com/product-detail/stmicroelectronics/stm32f031e6y6tr

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3.8 Direct memory access controller (DMA)

The 5-channel general-purpose DMAs manage memory-to-memory, peripheral-to-memory and memory-to-peripheral transfers.

The DMA supports circular buffer management, removing the need for user code intervention when the controller reaches the end of the buffer.

Each channel is connected to dedicated hardware DMA requests, with support for software trigger on each channel. Configuration is made by software and transfer sizes between source and destination are independent.

DMA can be used with the main peripherals: SPIx, I2Sx, I2Cx, USARTx, all TIMx timers (except TIM14) and ADC.

3.9 Interrupts and events

3.9.1 Nested vectored interrupt controller (NVIC)

The STM32F0xx family embeds a nested vectored interrupt controller able to handle up to 32 maskable interrupt channels (not including the 16 interrupt lines of Cortex®-M0) and 4 priority levels.

- Closely coupled NVIC gives low latency interrupt processing
- Interrupt entry vector table address passed directly to the core
- Closely coupled NVIC core interface
- 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

This hardware block provides flexible interrupt management features with minimal interrupt latency.

3.9.2 Extended interrupt/event controller (EXTI)

The extended interrupt/event controller consists of 24 edge detector lines used to generate interrupt/event requests and wake-up the system. Each 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 EXTI can detect an external line with a pulse width shorter than the internal clock period. Up to 39 GPIOs can be connected to the 16 external interrupt lines.

3.10 Analog-to-digital converter (ADC)

The 12-bit analog-to-digital converter has up to 16 external and 3 internal (temperature sensor, voltage reference, VBAT voltage measurement) channels and performs conversions in single-shot or scan modes. In scan mode, automatic conversion is performed on a selected group of analog inputs.

The ADC can be served by the DMA controller.

An analog watchdog feature allows very precise monitoring of the converted voltage of one, some or all selected channels. An interrupt is generated when the converted voltage is outside the programmed thresholds.

3.10.1 Temperature sensor

The temperature sensor (TS) generates a voltage V_{SENSE} that varies linearly with temperature.

The temperature sensor is internally connected to the ADC_IN16 input channel 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 3. 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}= 3.3 V (± 10 mV)	0x1FFF F7B8 - 0x1FFF F7B9
TS_CAL2	TS ADC raw data acquired at a temperature of 110 °C (± 5 °C), V_{DDA}= 3.3 V (± 10 mV)	0x1FFF F7C2 - 0x1FFF F7C3

3.10.2 Internal voltage reference (V_{REFINT})

The internal voltage reference (V_{REFINT}) provides a stable (bandgap) voltage output for the ADC. V_{REFINT} is internally connected to the ADC_IN17 input channel. The precise voltage of V_{REFINT} 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 4. Internal voltage reference calibration values

Calibration value name	Description	Memory address
VREFINT_CAL	Raw data acquired at a temperature of 30 °C (± 5 °C), V_{DDA}= 3.3 V (± 10 mV)	0x1FFF F7BA - 0x1FFF F7BB

3.10.3 V_{BAT} battery voltage monitoring

This embedded hardware feature allows the application to measure the V_{BAT} battery voltage using the internal ADC channel ADC_IN18. As the V_{BAT} voltage may be higher than V_{DDA}, and thus outside the ADC input range, the V_{BAT} pin is internally connected to a bridge divider by 2. As a consequence, the converted digital value is half the V_{BAT} voltage.

4 Pinouts and pin description

Figure 3. LQFP48 package pinout

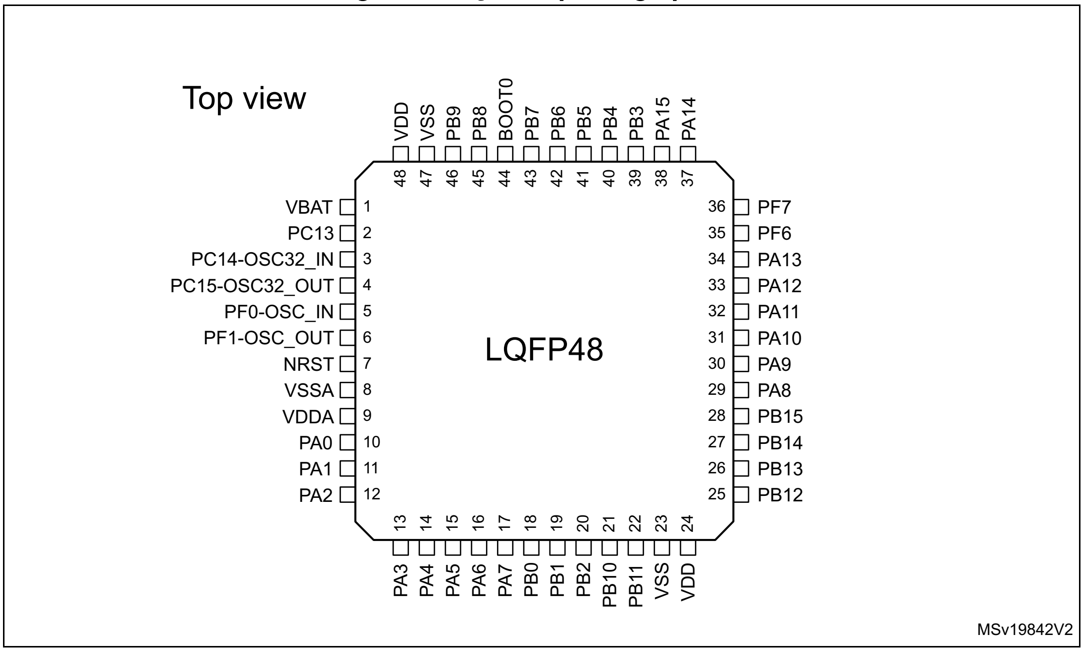


Figure 4. LQFP32 package pinout

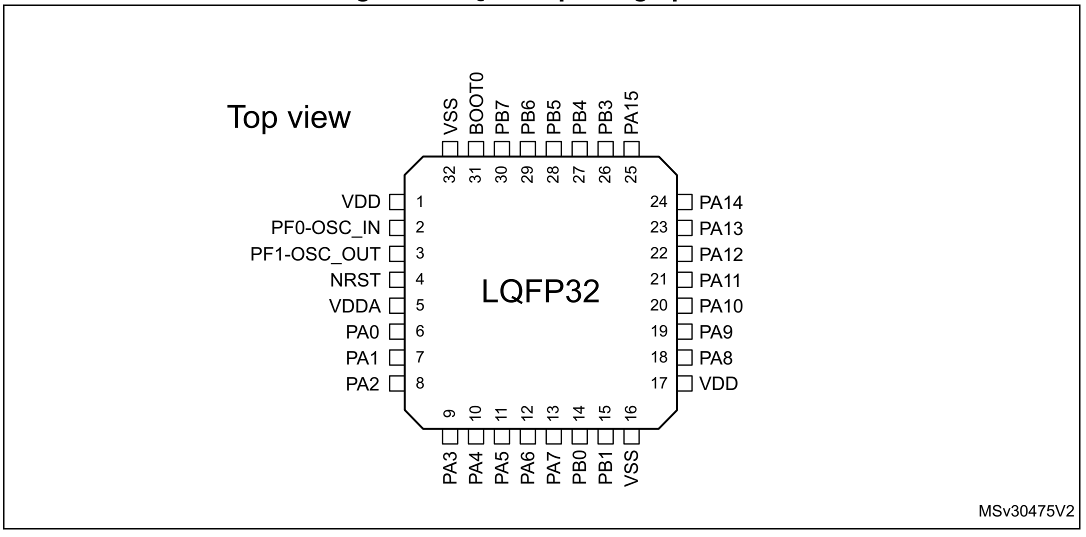


Table 11. Pin definitions (continued)

Pin number						Pin name (function upon reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP48	LQFP32	UFQFPN32	UFQFPN28	WLCSP25	TSSOP20					Alternate functions	Additional functions
6	3	3	3	B5	3	PF1-OSC_OUT (PF1)	I/O	FT	-	-	OSC_OUT
7	4	4	4	C5	4	NRST	I/O	RST	-	Device reset input / internal reset output (active low)	
8	16 (3)	0(3)	16 (3)	E1 (3)	15 (3)	VSSA	S		-	Analog ground	
9	5	5	5	D5	5	VDDA	S		-	Analog power supply	
10	6	6	6	B4	6	PA0	I/O	TTa	-	TIM2_CH1_ETR, USART1_CTS	ADC_IN0, RTC_TAMP2, WKUP1
11	7	7	7	C4	7	PA1	I/O	TTa	-	TIM2_CH2, EVENTOUT, USART1_RTS	ADC_IN1
12	8	8	8	D4	8	PA2	I/O	TTa	-	TIM2_CH3, USART1_TX	ADC_IN2
13	9	9	9	E5	9	PA3	I/O	TTa	-	TIM2_CH4, USART1_RX	ADC_IN3
14	10	10	10	B3	10	PA4	I/O	TTa	-	SPI1_NSS, I2S1_WS, TIM14_CH1, USART1_CK	ADC_IN4
15	11	11	11	C3	11	PA5	I/O	TTa	-	SPI1_SCK, I2S1_CK, TIM2_CH1_ETR	ADC_IN5
16	12	12	12	D3	12	PA6	I/O	TTa	-	SPI1_MISO, I2S1_MCK, TIM3_CH1, TIM1_BKIN, TIM16_CH1, EVENTOUT	ADC_IN6

Table 11. Pin definitions (continued)

Pin number						Pin name (function upon reset)	Pin type	I/O structure	Notes	Pin functions	
LQFP48	LQFP32	UFQFPN32	UFQFPN28	WLCSP25	TSSOP20					Alternate functions	Additional functions
41	28	28	26	C2	-	PB5	I/O	FT	-	SPI1_MOSI, I2S1_SD, I2C1_SMBA, TIM16_BKIN, TIM3_CH2	-
42	29	29	27	B2	-	PB6	I/O	FTf	-	I2C1_SCL, USART1_TX, TIM16_CH1N	-
43	30	30	28	A3	-	PB7	I/O	FTf	-	I2C1_SDA, USART1_RX, TIM17_CH1N	-
44	31	31	1	A4	1	BOOT0	I	B	-	Boot memory selection	
45	-	32	-	-	-	PB8	I/O	FTf	(4)	I2C1_SCL, TIM16_CH1	-
46	-	-	-	-	-	PB9	I/O	FTf	-	I2C1_SDA, IR_OUT, TIM17_CH1, EVENTOUT	-
47	32	0	-	E1	-	VSS	S	-	-	Ground	
48	1	1	-	-	-	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. VSSA pin is not in package pinout. VSSA pad of the die is connected to VSS pin.
4. On the LQFP32 package, PB2 and PB8 should be treated as unconnected pins (even when they are not available on the package, they are not forced to a defined level by hardware).
5. 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. On the WLCSP25 package, PB3, PB4 and PA15 must be set to defined levels by software, as their corresponding pads on the silicon die are left unconnected. Apply same recommendations as for unconnected pins.

Table 13. Alternate functions selected through GPIOB_AFR registers for port B

Pin name	AF0	AF1	AF2	AF3
PB0	EVENTOUT	TIM3_CH3	TIM1_CH2N	-
PB1	TIM14_CH1	TIM3_CH4	TIM1_CH3N	-
PB2	-	-	-	-
PB3	SPI1_SCK, I2S1_CK	EVENTOUT	TIM2_CH2	-
PB4	SPI1_MISO, I2S1_MCK	TIM3_CH1	EVENTOUT	-
PB5	SPI1_MOSI, I2S1_SD	TIM3_CH2	TIM16_BKIN	I2C1_SMBA
PB6	USART1_TX	I2C1_SCL	TIM16_CH1N	-
PB7	USART1_RX	I2C1_SDA	TIM17_CH1N	-
PB8	-	I2C1_SCL	TIM16_CH1	-
PB9	IR_OUT	I2C1_SDA	TIM17_CH1	EVENTOUT
PB10	-	I2C1_SCL	TIM2_CH3	-
PB11	EVENTOUT	I2C1_SDA	TIM2_CH4	-
PB12	SPI1_NSS	EVENTOUT	TIM1_BKIN	-
PB13	SPI1_SCK	-	TIM1_CH1N	-
PB14	SPI1_MISO	-	TIM1_CH2N	-
PB15	SPI1_MOSI	-	TIM1_CH3N	-

Table 14. STM32F031x4/x6 peripheral register boundary addresses (continued)

Bus	Boundary address	Size	Peripheral
APB	0x4000 7400 - 0x4000 7FFF	3KB	Reserved
	0x4000 7000 - 0x4000 73FF	1KB	PWR
	0x4000 5800 - 0x4000 6FFF	6KB	Reserved
	0x4000 5400 - 0x4000 57FF	1KB	I2C1
	0x4000 3400 - 0x4000 53FF	8KB	Reserved
	0x4000 3000 - 0x4000 33FF	1KB	IWDG
	0x4000 2C00 - 0x4000 2FFF	1KB	WWDG
	0x4000 2800 - 0x4000 2BFF	1KB	RTC
	0x4000 2400 - 0x4000 27FF	1KB	Reserved
	0x4000 2000 - 0x4000 23FF	1KB	TIM14
	0x4000 0800 - 0x4000 1FFF	6KB	Reserved
	0x4000 0400 - 0x4000 07FF	1KB	TIM3
	0x4000 0000 - 0x4000 03FF	1KB	TIM2

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 and are not tested in production. 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} = V_{DDA} = 3.3 V. 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 10*.

6.1.5 Pin input voltage

The input voltage measurement on a pin of the device is described in *Figure 11*.

Figure 10. Pin loading conditions

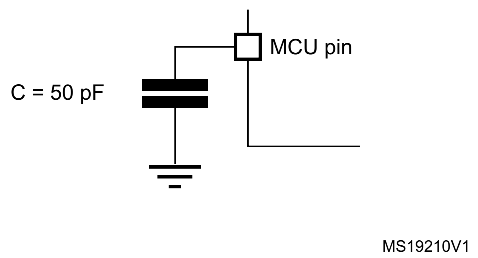
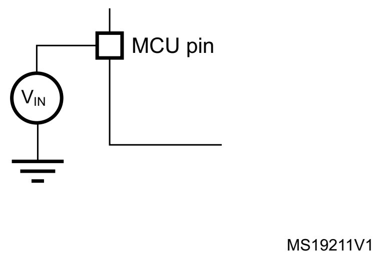


Figure 11. Pin input voltage



Typical and maximum current consumption

The MCU is placed under the following conditions:

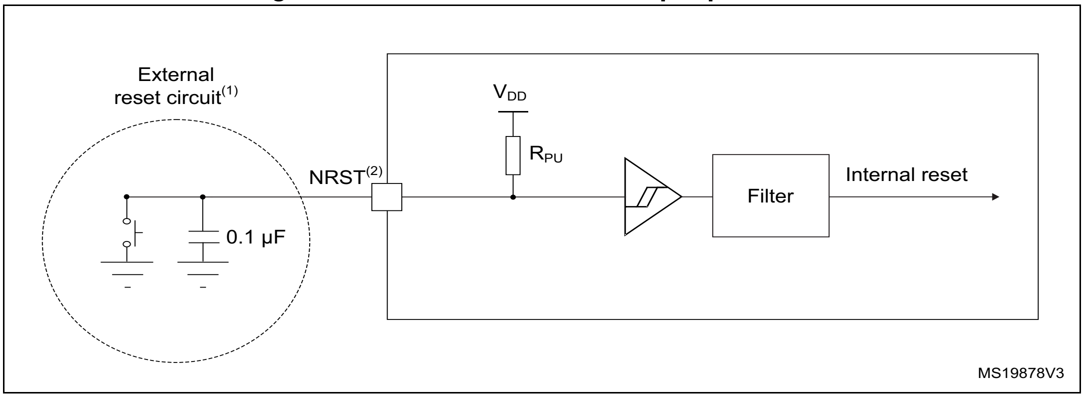
- All I/O pins are in analog input mode
- All peripherals are disabled except when explicitly mentioned
- The Flash memory access time is adjusted to the f_{HCLK} frequency:
  - 0 wait state and Prefetch OFF from 0 to 24 MHz
  - 1 wait state and Prefetch ON above 24 MHz
- When the peripherals are enabled $f_{PCLK} = f_{HCLK}$

The parameters given in *Table 23Table 23* to *Table 27* are derived from tests performed under ambient temperature and supply voltage conditions summarized in *Table 18: General operating conditions*.

Table 23. Typical and maximum current consumption from V_{DD} at 3.6 V

Symbol	Parameter	Conditions	f_{HCLK}	All peripherals enabled				All peripherals disabled				Unit
				Typ	Max @ T_A(1)			Typ	Max @ T_A(1)			
					25 °C	85 °C	105 °C		25 °C	85 °C	105 °C	
I_{DD}	Supply current in Run mode, code executing from Flash memory	HSE bypass, PLL on	48 MHz	18.4	20.0	20.1	20.4	11.4	12.5	12.5	12.6	mA
			32 MHz	12.4	13.2	13.2	13.8	7.9	8.3	8.5	8.6	
			24 MHz	9.9	10.7	10.7	11.0	6.2	6.8	7.0	7.0	
		HSE bypass, PLL off	8 MHz	3.3	3.6	3.8	3.9	2.2	2.6	2.6	2.6	
			1 MHz	0.8	1.1	1.1	1.1	0.7	0.9	0.9	0.9	
		HSI clock, PLL on	48 MHz	18.9	20.9	21.1	21.5	11.7	12.3	12.9	13.1	
			32 MHz	12.8	13.7	14.2	14.8	8.0	8.7	9.1	9.1	
			24 MHz	9.7	10.4	11.2	11.3	6.1	6.5	6.7	6.9	
		HSI clock, PLL off	8 MHz	3.5	4.0	4.0	4.1	2.4	2.6	2.7	2.7	
	Supply current in Run mode, code executing from RAM	HSE bypass, PLL on	48 MHz	17.3	19.7(2)	19.8	20.0(2)	10.3	11.2(2)	11.3	11.7(2)	
			32 MHz	11.2	12.5	12.7	12.7	6.7	7.3	7.6	7.6	
			24 MHz	8.9	10.0	10.1	10.2	5.1	5.5	5.8	5.9	
		HSE bypass, PLL off	8 MHz	2.8	3.1	3.3	3.4	1.7	2.0	2.1	2.1	
			1 MHz	0.3	0.6	0.6	1.3	0.2	0.5	0.8	0.9	
		HSI clock, PLL on	48 MHz	17.4	19.7	20.0	20.2	10.4	11.2	11.3	11.8	
			32 MHz	11.8	12.8	13.1	13.3	6.8	7.4	7.7	7.9	
			24 MHz	9.0	10.0	10.1	10.2	5.2	5.7	6.0	6.0	
		HSI clock, PLL off	8 MHz	3.0	3.2	3.5	3.6	1.8	2.0	2.2	2.2	

Figure 23. Recommended NRST pin protection



1. The external capacitor protects the device against parasitic resets.
2. The user must ensure that the level on the NRST pin can go below the $V_{IL(NRST)}$ max level specified in *Table 49: NRST pin characteristics*. Otherwise the reset will not be taken into account by the device.

6.3.16 12-bit ADC characteristics

Unless otherwise specified, the parameters given in *Table 50* are derived from tests performed under the conditions summarized in *Table 18: General operating conditions*.

Note: It is recommended to perform a calibration after each power-up.

Table 50. ADC characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DDA}	Analog supply voltage for ADC ON	-	2.4	-	3.6	V
$I_{DDA\ (ADC)}$	Current consumption of the ADC(1)	V_{DDA} = 3.3 V	-	0.9	-	mA
f_{ADC}	ADC clock frequency	-	0.6	-	14	MHz
f_S(2)	Sampling rate	12-bit resolution	0.043	-	1	MHz
f_{TRIG}(2)	External trigger frequency	f_{ADC} = 14 MHz, 12-bit resolution	-	-	823	kHz
		12-bit resolution	-	-	17	$1/f_{ADC}$
V_{AIN}	Conversion voltage range	-	0	-	V_{DDA}	V
R_{AIN}(2)	External input impedance	See *Equation 1* and *Table 51* for details	-	-	50	kΩ
R_{ADC}(2)	Sampling switch resistance	-	-	-	1	kΩ
C_{ADC}(2)	Internal sample and hold capacitor	-	-	-	8	pF
t_{CAL}(2)(3)	Calibration time	f_{ADC} = 14 MHz	5.9			µs
		-	83			$1/f_{ADC}$

Figure 24. ADC accuracy characteristics

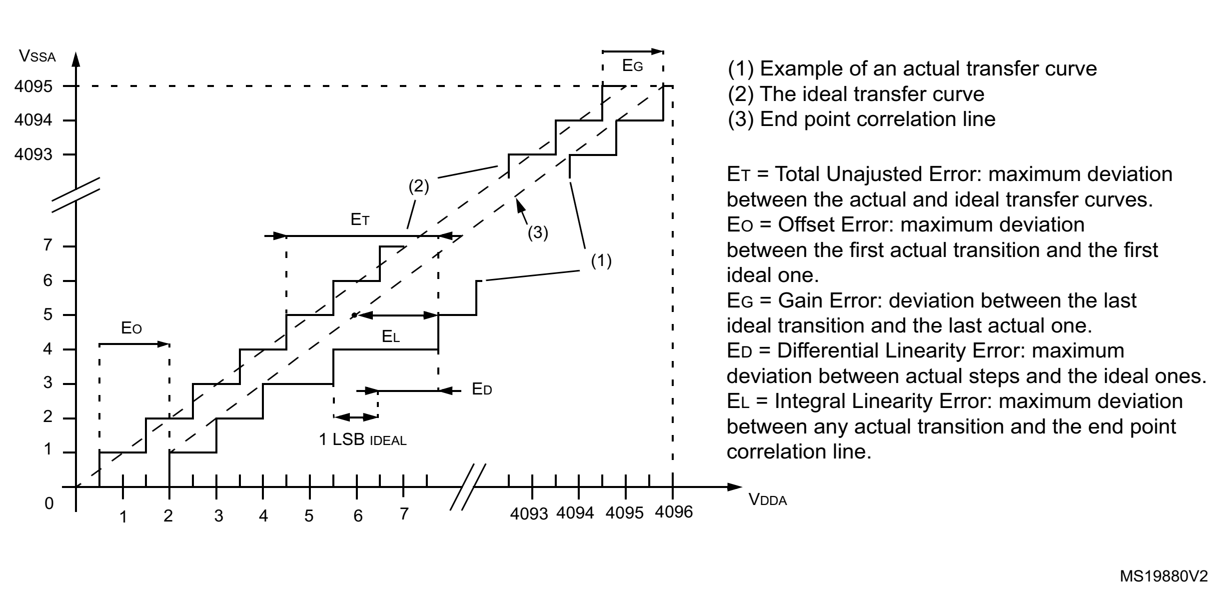
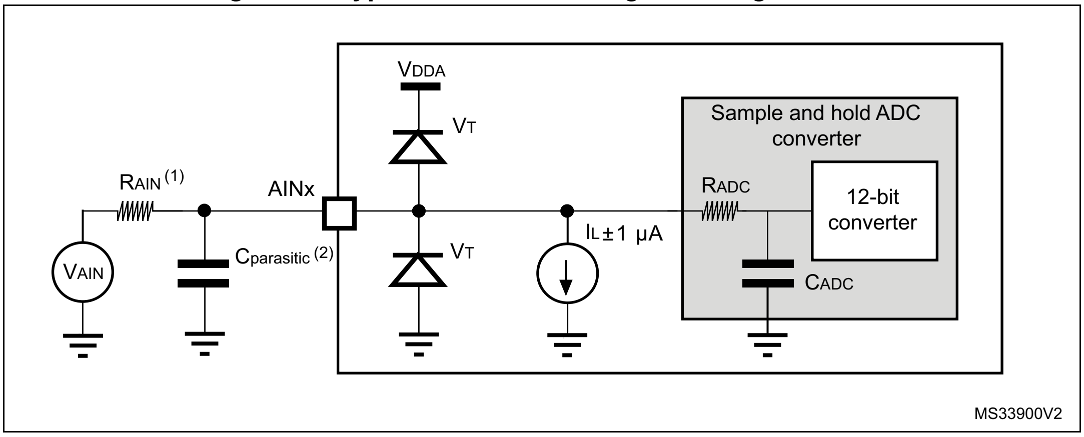


Figure 25. Typical connection diagram using the ADC



1. Refer to *Table 50: ADC characteristics* for the values of R_{AIN}, R_{ADC} and C_{ADC}.
2. $C_{parasitic}$ represents the capacitance of the PCB (dependent on soldering and PCB layout quality) plus the pad capacitance (roughly 7 pF). A high $C_{parasitic}$ value will downgrade conversion accuracy. To remedy this, f_{ADC} should be reduced.

General PCB design guidelines

Power supply decoupling should be performed as shown in *Figure 12: Power supply scheme*. The 10 nF capacitor should be ceramic (good quality) and it should be placed as close as possible to the chip.

Table 58. I²C analog filter characteristics(1)

Symbol	Parameter	Min	Max	Unit
t_{AF}	Maximum width of spikes that are suppressed by the analog filter	50(2)	260(3)	ns

1. Guaranteed by design, not tested in production.
2. Spikes with widths below $t_{AF(min)}$ are filtered.
3. Spikes with widths above $t_{AF(max)}$ are not filtered

SPI/I²S characteristics

Unless otherwise specified, the parameters given in *Table 59* for SPI or in *Table 60* for I²S are derived from tests performed under the ambient temperature, f_{PCLKx} frequency and supply voltage conditions summarized in *Table 18: General operating conditions*.

Refer to *Section 6.3.14: I/O port characteristics* for more details on the input/output alternate function characteristics (NSS, SCK, MOSI, MISO for SPI and WS, CK, SD for I²S).

Table 59. SPI characteristics(1)

Symbol	Parameter	Conditions	Min	Max	Unit
f_{SCK} $1/t_{c(SCK)}$	SPI clock frequency	Master mode	-	18	MHz
		Slave mode	-	18	
$t_{r(SCK)}$ $t_{f(SCK)}$	SPI clock rise and fall time	Capacitive load: C = 15 pF	-	6	ns
$t_{su(NSS)}$	NSS setup time	Slave mode	4Tpclk	-	ns
$t_{h(NSS)}$	NSS hold time	Slave mode	2Tpclk + 10	-	
$t_{w(SCKH)}$ $t_{w(SCKL)}$	SCK high and low time	Master mode, f_{PCLK} = 36 MHz, presc = 4	Tpclk/2 -2	Tpclk/2 + 1	
$t_{su(MI)}$ $t_{su(SI)}$	Data input setup time	Master mode	4	-	
		Slave mode	5	-	
$t_{h(MI)}$	Data input hold time	Master mode	4	-	
$t_{h(SI)}$		Slave mode	5	-	
$t_{a(SO)}$(2)	Data output access time	Slave mode, f_{PCLK} = 20 MHz	0	3Tpclk	
$t_{dis(SO)}$(3)	Data output disable time	Slave mode	0	18	
$t_{v(SO)}$	Data output valid time	Slave mode (after enable edge)	-	22.5	
$t_{v(MO)}$	Data output valid time	Master mode (after enable edge)	-	6	
$t_{h(SO)}$	Data output hold time	Slave mode (after enable edge)	11.5	-	
$t_{h(MO)}$		Master mode (after enable edge)	2	-	
DuCy(SCK)	SPI slave input clock duty cycle	Slave mode	25	75	%

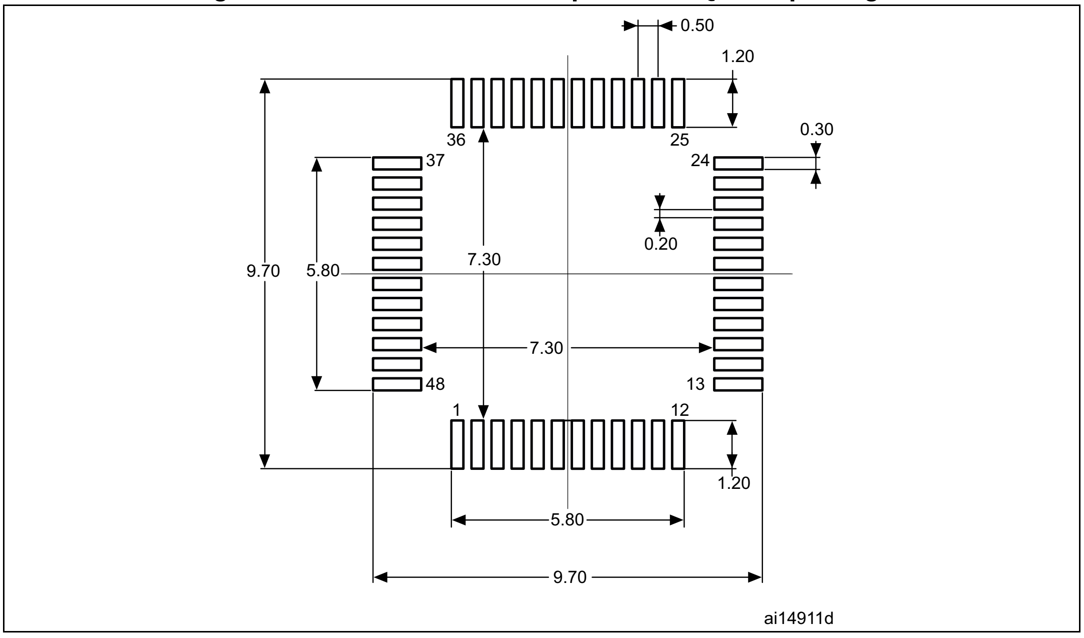
1. Data based on characterization results, not tested in production.
2. Min time is for the minimum time to drive the output and the max time is for the maximum time to validate the data.
3. Min time is for the minimum time to invalidate the output and the max time is for the maximum time to put the data in Hi-Z

Table 61. LQFP48 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	8.800	9.000	9.200	0.3465	0.3543	0.3622
D1	6.800	7.000	7.200	0.2677	0.2756	0.2835
D3	-	5.500	-	-	0.2165	-
E	8.800	9.000	9.200	0.3465	0.3543	0.3622
E1	6.800	7.000	7.200	0.2677	0.2756	0.2835
E3	-	5.500	-	-	0.2165	-
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 32. Recommended footprint for LQFP48 package



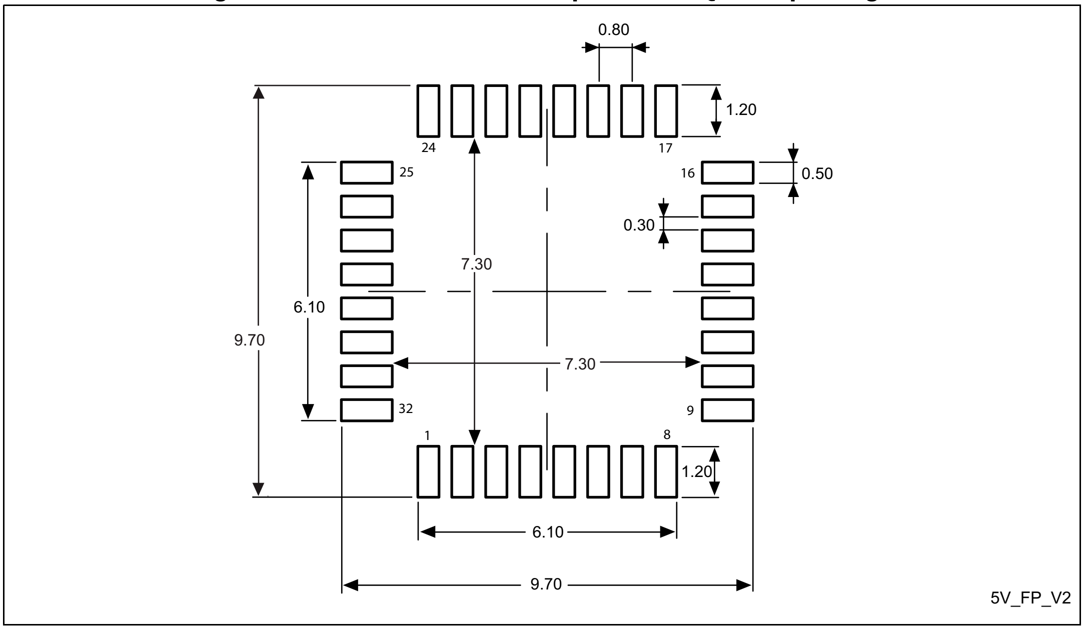
1. Dimensions are expressed in millimeters.

Table 62. LQFP32 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	0.300	0.370	0.450	0.0118	0.0146	0.0177
c	0.090	-	0.200	0.0035	-	0.0079
D	8.800	9.000	9.200	0.3465	0.3543	0.3622
D1	6.800	7.000	7.200	0.2677	0.2756	0.2835
D3	-	5.600	-	-	0.2205	-
E	8.800	9.000	9.200	0.3465	0.3543	0.3622
E1	6.800	7.000	7.200	0.2677	0.2756	0.2835
E3	-	5.600	-	-	0.2205	-
e	-	0.800	-	-	0.0315	-
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	-	-	0.100	-	-	0.0039

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

Figure 35. Recommended footprint for LQFP32 package



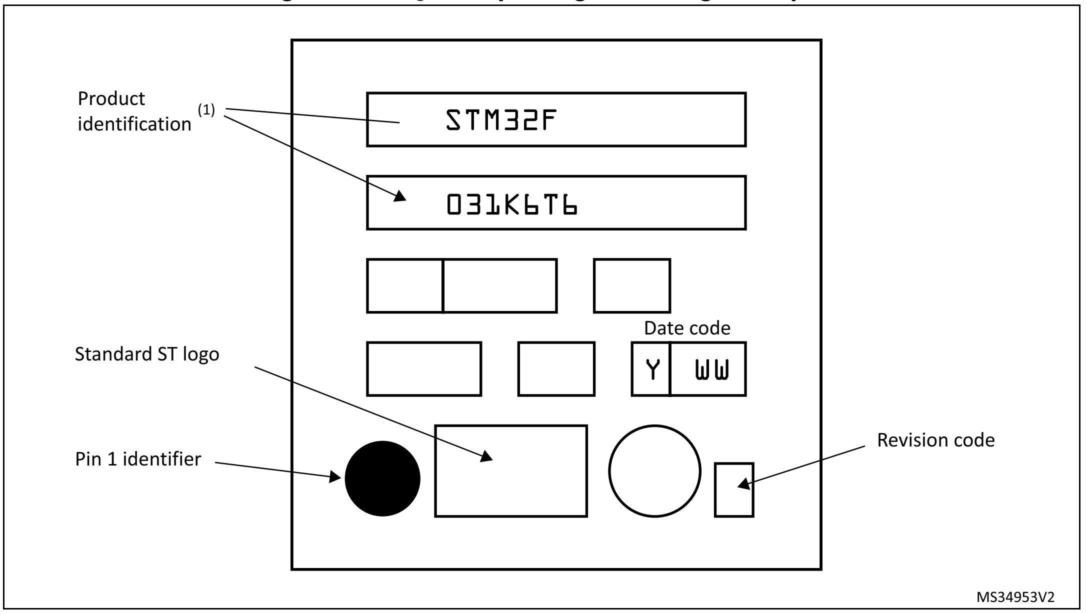
1. Dimensions are expressed in millimeters.

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 36. LQFP32 package marking example



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.

7.3 UFQFPN32 package information

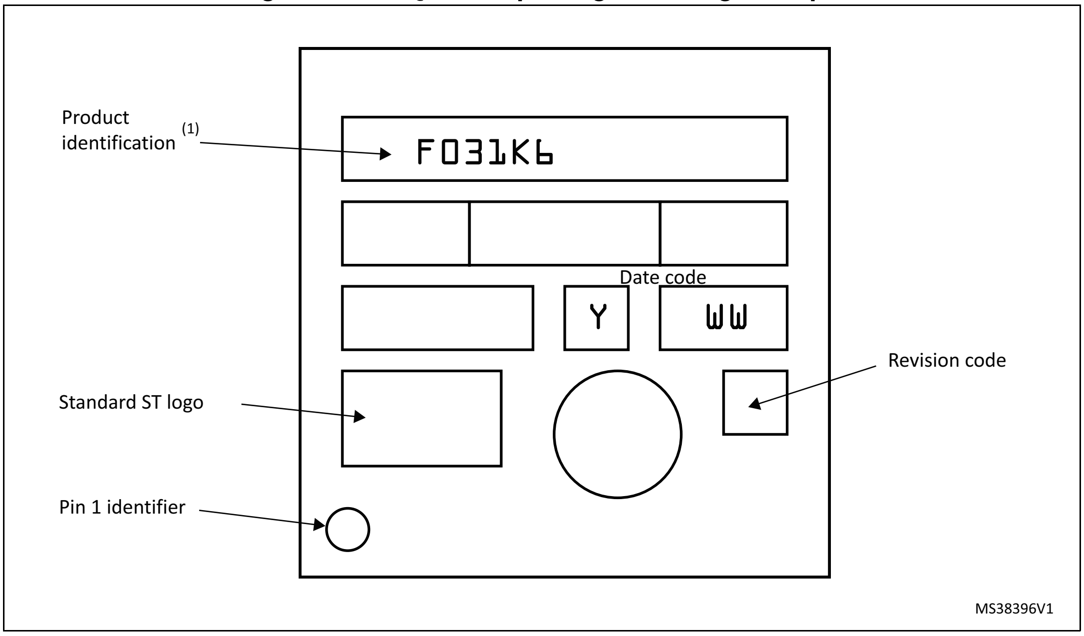
UFQFPN32 is a 32-pin, 5x5 mm, 0.5 mm pitch ultra-thin fine-pitch quad flat package.

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 39. UFQFPN32 package marking example

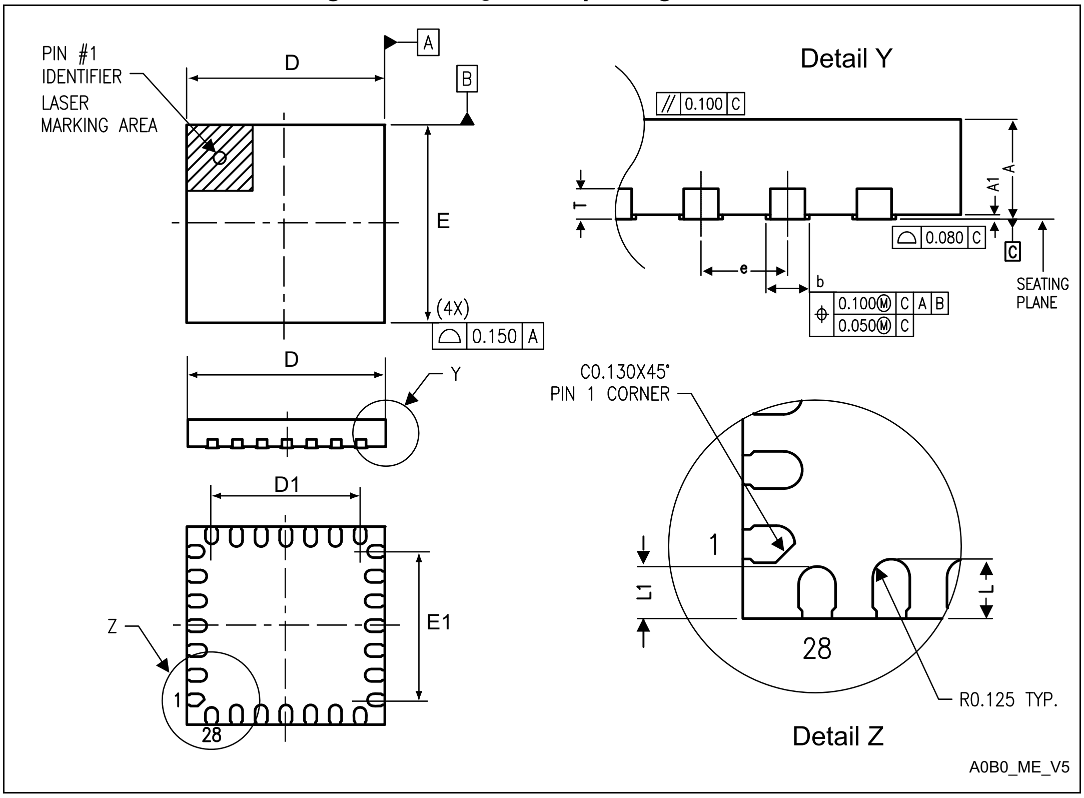


1. Parts marked as "ES", "E" or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering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

7.4 UFQFPN28 package information

UFQFPN28 is a 28-lead, 4x4 mm, 0.5 mm pitch, ultra-thin fine-pitch quad flat package.

Figure 40. UFQFPN28 package outline



1. Drawing is not to scale.

Table 64. UFQFPN28 package mechanical data(1)

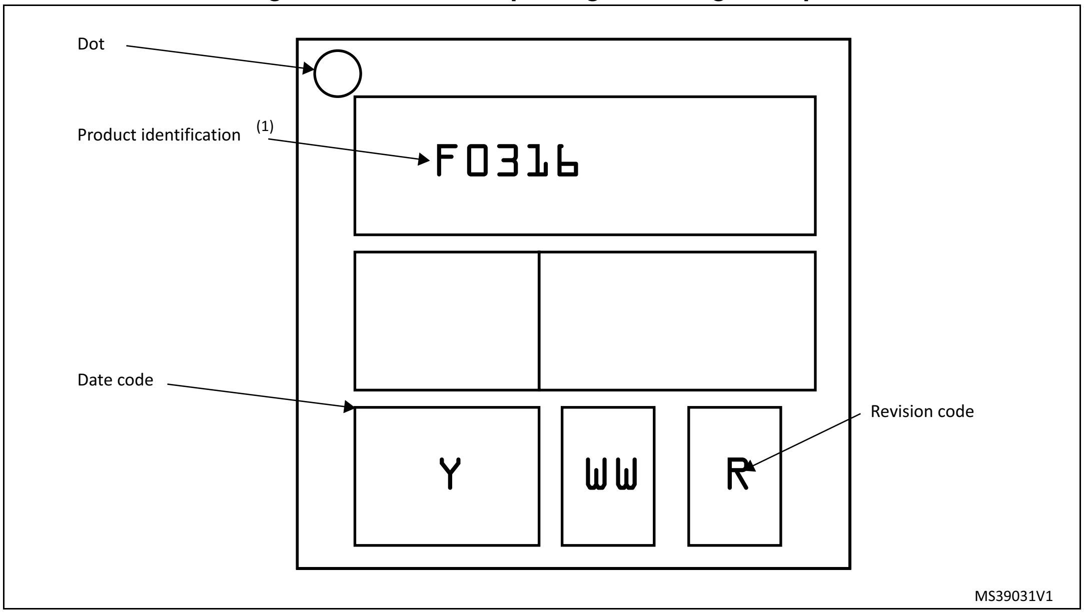
Symbol	millimeters			inches		
	Min	Typ	Max	Min	Typ	Max
A	0.500	0.550	0.600	0.0197	0.0217	0.0236
A1	-	0.000	0.050	-	0.0000	0.0020
D	3.900	4.000	4.100	0.1535	0.1575	0.1614
D1	2.900	3.000	3.100	0.1142	0.1181	0.1220
E	3.900	4.000	4.100	0.1535	0.1575	0.1614
E1	2.900	3.000	3.100	0.1142	0.1181	0.1220
L	0.300	0.400	0.500	0.0118	0.0157	0.0197
L1	0.250	0.350	0.450	0.0098	0.0138	0.0177
T	-	0.152	-	-	0.0060	-
b	0.200	0.250	0.300	0.0079	0.0098	0.0118
e	-	0.500	-	-	0.0197	-

Device marking

The following figure gives an example of topside marking orientation versus ball A1 identifier location.

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

Figure 45. WLCSP25 package marking example



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.

9 Revision history

Table 70. Document revision history

Date	Revision	Changes
13-Jan-2014	1	Initial release.
11-Jul-2014	2	Changed the document status to Datasheet - production data. Updated the following: – *Table: STM32F031x4/6 family device features and peripheral counts,* – *Figure: Clock tree*, – *Figure: Power supply scheme*, – *Table: Peripheral current consumption*. Replaced *Table Typical current consumption in Run mode, code with data processing running from Flash* and *Table Typical current consumption in Sleep mode, code running from Flash or RAM* with *Table: Typical current consumption, code executing from Flash, running from HSE 8 MHz crystal.* Added the LQFP32 package: updates in *Section: Description, Section: Pinouts and pin description* and *Section: Package information.*
28-Aug-2015	3	**Updated:** – *Figure 9: STM32F031x6 memory map* – AF1 alternate functions for PA0, PA1, PA2, PA3 and PA4 in *Table 12: Alternate functions selected through GPIOA_AFR registers for port A* – the footnote for V_{IN} max value in *Table 15: Voltage characteristics* – the footnote for max V_{IN} in *Table 18: General operating conditions* – *Table 22: Embedded internal reference voltage* with the addition of t_{START} parameter – *Table 50: ADC characteristics* – *Table 53: TS characteristics*: removed the min. value for t_{START} parameter – the typical value for R parameter in *Table 54: VBAT monitoring characteristics* – the structure of *Section 7: Package information*. **Added:** – *Figure 33: LQFP48 marking example (package top view), Figure 36: LQFP32 marking example (package top view), Figure 39: UFQFPN32 marking example (package top view), Figure 42: UFQFPN28 marking example (package top view), Figure 48: TSSOP20 marking example (package top view)*