



# HC32L07x Series

**32-bit ARM® Cortex®-M0+ microcontrollers**

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Data sheet

Rev1.85 March 2025

## Product Features

- 48MHz Cortex-M0+ 32-bit CPU
- HC32L072 / HC32L073 series with flexible power management system
  - 1.2μA @ 3V deep sleep mode: all clocks off, power-on reset valid, IO state retained, IO interrupt valid, all registers, RAM and CPU data saved
  - 1.6μA @3V deep sleep mode + RTC running
  - 9μA @32.768kHz low-speed run mode: CPU running, peripherals off, program running from FLASH
  - 40μA/MHz@3V@24MHz sleep mode: CPU stopped, peripherals off, main clock running
  - 140μA/MHz@3V@24MHz working mode: CPU running, peripherals off, program running from FLASH
  - 4μs Wake-up time, making mode switching more flexible and efficient, and the system more responsive
- 128K bytes of FLASH memory with erase and write protection function, supporting ISP, ICP, IAP
- 16K bytes of RAM memory with parity check to enhance system stability
- General I/O pins
- Clock, crystal oscillator
  - External high-speed crystal oscillator 8 ~ 32MHz
  - External low-speed crystal oscillator 32.768kHz
  - Internal high-speed clock 4/8/16/22.12/24MHz
  - Internal low-speed clock 32.8/38.4kHz
  - PLL clock 8 ~ 48MHz
  - Internal high-speed USB clock 48MHz
  - Hardware supports internal and external clock calibration and monitoring
- Timer/Counter
  - 3 general-purpose 16-bit timers, support 1 group of complementary PWM output, support double main frequency PWM output, support up to 96MHz PWM output
  - 1 advanced 16-bit timer, support 3-phase complementary PWM output, support double main frequency PWM output, support up to 96MHz PWM output
  - 3 high-performance 16-bit timer/counters, support PWM complementary, dead zone protection function
  - 1 ultra-low power pulse counter PCNT, with automatic timed wake-up function in low power mode, maximum timing up to 1024 seconds
  - 1 programmable 16-bit PCA, supporting 5-channel capture-compare,
- 5-channel PWM output
  - 2 low-power 16-bit timers, support cascading
  - 1 20-bit programmable watchdog circuit, built-in dedicated 10kHz oscillator provides WDT counting
- Communication interfaces
  - 4 UART standard communication interfaces
  - 2 LPUART low-power communication interfaces, can work in deep sleep mode
  - 2 SPI standard communication interfaces
  - 2 I2C standard communication interfaces
  - 2 I2S audio communication interfaces
  - 1 Crystal-less USB Full Speed Device
  - 1 CAN 2.0B standard communication interface
- Buzzer frequency generator, support complementary output
- Hardware perpetual calendar RTC module
- Hardware CRC-16/32 module
- Hardware 32-bit divider
- AES-128/192/256 hardware coprocessor
- TRNG True Random Number Generator
- 2-channel DMAC
- 4\*52 / 6\*50 / 8\*48 LCD driver (073 series only)
- Globally unique 10-byte ID number
- 12-bit 1Msps sampling high-speed and high-precision SARADC, built-in op amp, can measure high output impedance signals
- 2-channel 12-bit 500Ksps DAC
- Integrated 5 multi-function operational amplifiers, two of which can be used as output buffers for 2 DACs
- Integrated 3-channel voltage comparator with 6-bit DAC and programmable comparison reference
- Integrated low voltage detector, configurable 16-step comparison voltage, can monitor port voltage and power supply voltage
- SWD debugging solution, providing full-function debugger
- Operating conditions: -40 ~ 85°C, 1.8 ~ 5.5V
- Package: LQFP100/ 64/ 48, QFN32

### Supported models:

HC32L072PATA-LQFP100	HC32L072KATA-LQFP64
HC32L072JATA-LQ48	HC32L072FAUA-QN32TR
HC32L073PATA-LQFP100	HC32L073KATA-LQFP64
HC32L073JATA-LQ48	

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## 1 Introduction

The HC32L072/HC32L073 series is an ultra-low power, wide voltage range MCU designed to extend the battery life of portable measurement systems. It integrates a 12-bit 1Msps high-precision SARADC, 2 12-bit DACs, and integrates comparators, op amps, built-in high-performance PWM timers, LCD displays, multiple UARTs, SPI, I2C, I2S, USB, CAN and other rich communication peripherals, built-in AES, TRNG and other information security modules, with high integration, high anti-interference, high reliability and ultra-low power consumption. The core of this product adopts the Cortex-M0+ core, with mature Keil & IAR debugging and development software, supports C language and assembly language, assembly instructions.

### Ultra-low power MCU typical applications

- Sensor applications, IoT applications
- Smart meters, wireless modules, thermostats, shelf labels
- Smart transportation, alarm systems
- Smart homes, medical equipment

## 1.1 32-bit Cortex M0+ core

The ARM® Cortex®-M0+ processor is derived from the Cortex-M0 and includes a 32-bit RISC processor with a computing power of 0.95 Dhystone MIPS/MHz. At the same time, it has added a number of new designs, improved debugging and tracing capabilities, reduced the number of instruction cycles (IPCs) per instruction, improved two-stage pipelines for Flash access, and incorporated energy-saving and power-reduction technologies. The Cortex-M0+ processor fully supports the integrated Keil & IAR debuggers.

The Cortex-M0+ includes a hardware debugging circuit that supports a 2-pin SWD debugging interface.

ARM Cortex-M0+ features:

Instruction set	Thumb/ Thumb-2
Pipeline	2-stage pipeline
Performance efficiency	2.46 CoreMark/ MHz
Performance efficiency	0.95 DMIPS/ MHz in Dhystone
Interrupts	32 fast interrupts
Interrupt priority	Configurable 4-level interrupt priority
Enhanced instructions	Single-cycle 32-bit multiplier
Debug	Serial-wire debug port, supports 4 hard interrupts (break point) and 2 watch points (watch point)

## 1.2 128K Byte FLASH

Built-in fully integrated FLASH controller, no external high voltage input is required, high voltage is generated by the fully built-in circuit for programming. Supports ISP, IAP, ICP functions.

## 1.3 16K Byte RAM

RAM data will be retained according to different power consumption modes selected by customers. Comes with hardware parity bit, in case the data is accidentally damaged, when the data is read, the hardware circuit will immediately generate an interrupt to ensure the reliability of the system.

## 1.4 Clock System

A configurable high-precision internal clock RCH with a frequency of 4~24MHz. When configured at 24MHz, the wake-up time from low-power mode to working mode is 4us, and the frequency deviation is small within the full voltage and temperature range, so there is no need to connect an expensive high-frequency crystal.

An external crystal oscillator XTH with a frequency of 8~32MHz.

An external crystal oscillator XTL with a frequency of 32.768kHz.

An internal clock RCL with a frequency of 32.8/38.4kHz.

A PLL with an output frequency of 8~48MHz.

## 1.5 Operating Modes

- 1) Active Mode: CPU is running and peripheral function modules are running.
- 2) Sleep Mode: CPU stops running and peripheral function modules are running.
- 3) Deep Sleep Mode: CPU stops running, high-speed clock stops, and low-power function modules are running.

## 1.6 Real-time Clock RTC

RTC (Real Time Counter) is a register that supports BCD data. It uses a 32.768kHz crystal oscillator as its clock and can realize the perpetual calendar function. The interrupt cycle can be configured as year/month/day/hour/minute/second. 24/12 hour time mode, hardware automatically corrects leap year. It has precision compensation function, with the highest accuracy of 0.96ppm. The internal temperature sensor or external temperature sensor can be used for precision compensation, and the year/month/day/hour/minute/second can be adjusted by software +1/-1, with the minimum adjustable accuracy of 1 second.

The RTC calendar recorder used to indicate time and date will not clear the retained value when the MCU is reset due to external factors. It is the best choice for measuring equipment that requires a permanent high-precision real-time clock.

## 1.7 Port Controller GPIO

Up to 86 GPIO ports can be provided, some of which are multiplexed with analog ports. Each port is controlled by an independent control register bit and supports FAST IO. Support edge-triggered interrupts and level-triggered interrupts, and can wake up the MCU from various deep sleep modes to working modes. Support position, clear, and position clear operations. Support Push-Pull CMOS push-pull output and Open-Drain output. Built-in pull-up resistors and pull-down resistors, with Schmitt trigger input filtering function. The output drive capability is configurable, and the maximum current drive capability supports 18mA. All general IOs can support external asynchronous interrupts.

## 1.8 Interrupt Controller NVIC

The Cortex-M0+ processor has a built-in nested vector interrupt controller (NVIC), which supports up to 32 interrupt request (IRQ) inputs; it has four interrupt priority levels, can handle complex logic, and can perform real-time control and interrupt processing.

The 32 interrupt entry vector addresses are:

Interrupt vector number	Interrupt Source
[0]	GPIO_PA
[1]	GPIO_PB
[2]	GPIO_PC/GPIO_PE
[3]	GPIO_PD/GPIO_PF
[4]	DMAC
[5]	TIM3
[6]	UART0/UART2
[7]	UART1/UART3
[8]	LPUART0
[9]	LPUART1
[10]	SPI0/I2S0
[11]	SPI1/I2S1
[12]	I2C0
[13]	I2C1
[14]	TIM0
[15]	TIM1
[16]	TIM2
[17]	LPTIM0/LPTIM1
[18]	TIM4
[19]	TIM5
[20]	TIM6
[21]	PCA
[22]	WDT
[23]	RTC
[24]	ADC/DAC
[25]	PCNT
[26]	VC0/VC1/VC2/ LVD
[27]	USB
[28]	CAN
[29]	LCD
[30]	RAM FLASH
[31]	CLKTRIM /CTS

## 1.9 Reset Controller RESET

This product has 7 reset signal sources. Each reset signal can make the CPU run again. Most registers will be reset and the program counter PC will point to the starting address.

	Reset Source
[0]	Power-on reset POR BOR
[1]	External reset pin reset
[2]	WDT reset
[3]	PCA reset
[4]	Cortex-M0+ LOCKUP hardware reset
[5]	Cortex-M0+ SYSRESETREQ software reset
[6]	LVD reset

## 1.10 DMA Controller DMAC

The DMAC (Direct Memory Access Controller) function block can transfer data at high speed without going through the CPU. Using DMAC can improve system performance.

- DMAC is equipped with an independent bus, so DMAC can perform transfer operations even when the CPU bus is used.
- It consists of 2 channels and can perform 2 independent DMA transfers.
- The transfer destination address, transfer source address, transfer data size, transfer request source and transfer mode can be set, and the start of transfer operation, forced termination of transfer and suspension of transfer can be controlled for each channel.
- The start, forced termination and suspension of batch transfers for all channels can be controlled.
- When multiple channels are operated simultaneously, the priority of the operating channel can be selected by a fixed method or a round-robin method.
- Supports hardware DMA transfer using peripheral interrupt signals.
- Complies with the system bus (AHB) and supports 32-bit address space (4GB).

## 1.11 Timer TIM

Type	Name	Bit Width	Prescaler	Count Direction	PWM	Capture	Complementary Output
General purpose timer	TIM0	16/32	1/2/4/8/16/ 32/64/256	Up Down Up and down	2	2	1
	TIM1	16/32	1/2/4/8/16/ 32/64/256	Up Down Up and down	2	2	1
	TIM2	16/32	1/2/4/8/16/ 32/64/256	Up Down Up and down	2	2	1
	TIM3	16/32	1/2/4/8/16/ 32/64/256	Up Down Up and down	6	6	3
Low Power Timer	LPTIM0	16	1/2/4/8/16/ 32/64/256	Up	None	None	None
	LPTIM1	16	1/2/4/8/16/ 32/64/256	Up	None	None	None
Programmable Counter Array	PCA	16	2/4/8/16/32	Up	5	5	None
Advanced Timer	TIM4	16	1/2/4/8/16/ 64/256/1024	Up Down Up and down	2	2	1
	TIM5	16	1/2/4/8/16/ 64/256/1024	Up Down Up and down	2	2	1
	TIM6	16	1/2/4/8/16/ 64/256/1024	Up Down Up and down	2	2	1

The general timer includes four timers TIM0/1/2/3.

General timer features:

- PWM independent output, complementary output
- Capture input
- Dead zone control
- Brake control
- Edge-aligned, symmetrical center-aligned and asymmetrical center-aligned PWM outputs
- Quadrature encoding counting function
- Single pulse mode
- External counting function

TIM0/1/2 have the same functions. TIM0/1/2 is a synchronous timer/counter, which can be used as a 16-bit timer/counter with automatic reload function or a 32-bit timer/counter without reload function. Each timer of TIM0/1/2 has 2 capture and compare functions, which can generate 2 independent PWM outputs or 1 group of PWM complementary outputs. It has a dead zone control function.

TIM3 is a multi-channel general-purpose timer with all the functions of TIM0/1/2, which can generate 3 groups of PWM complementary outputs or 6 independent PWM outputs, and up to 6 input captures. It has a dead zone control function.

Low-power timer LPTIM is an asynchronous 16-bit timer/counter, which can still time/count through internal low-speed RC or external low-speed crystal oscillator after the system clock is turned off. The system can be woken up in low-power mode through interrupts.

PCA (Programmable Counter Array) supports up to 5 16-bit capture/compare modules. The timer/counter can be used as a general clock count/event counter with capture/compare functions. Each module of the PCA can be independently programmed to provide input capture, output comparison or pulse width modulation. In addition, module 4 has an additional watchdog timer mode.

The Advanced Timer contains three timers TIM4/5/6. TIM4/5/6 are high-performance counters with the same functions. They can be used to count and generate clock waveforms in different forms. One timer can generate a complementary pair of PWM or independent 2-way PWM outputs, and can capture external inputs for pulse width or period measurement.

The basic functions and features of the Advanced Timer are shown in the table:

Waveform Mode	Sawtooth wave, triangle wave
Basic Functions	• Incremental and decremental counting direction
	• Software synchronization
	• Hardware synchronization
	• Cache function
	• Quadrature encoding counting
	• General PWM output
	• Protection mechanism
	• AOS associated action
Interrupt Type	Count compare match interrupt
	Count period match interrupt
	Dead time error interrupt

## 1.12 Pulse Counter PCNT

The PCNT (Pulse Counter) module is used to count external pulses, supporting single and dual (quadrature coded and non-cross coded) pulses. It can count without software involvement in low-power sleep mode.

Pulse Counter Features:

- 16-bit counter with reload function
- Single-channel pulse counting

- Dual-channel non-quadrature pulse counting
- Dual-channel quadrature pulse counting, no missing codes
- Up/down count overflow interrupt
- Pulse timeout interrupt
- 4 decoding error interrupts, non-quadrature pulse mode
- 1 direction change interrupt, quadrature pulse mode
- Multi-level pulse width filtering
- Configurable input pulse polarity
- Support low power mode counting
- Support wake-up of MCU in low power mode
- Support any pulse edge spacing not less than 1 counting clock cycle
- With automatic timed wake-up function in low power mode, the maximum timer is 1024 seconds

## 1.13 Watchdog Timer WDT

WDT (Watch Dog Timer) is a configurable 20-bit timer that provides reset in case of MCU abnormality; built-in 10kHz low-speed clock input as counter clock. In debug mode, you can choose to pause or continue running; only writing a specific sequence can restart WDT.

## 1.14 Universal Synchronous Asynchronous Receiver Transmitter UART0~UART3

4 Universal Asynchronous Receiver/Transmitter, UART0~UART3.

Basic functions of UART:

- Half-duplex and full-duplex transmission
- 8/ 9-Bit transmission data length
- Hardware parity check
- 1/ 1.5/ 2-Bit stop bit
- Four different transmission modes
- 16-Bit baud rate generator
- Multi-machine communication
- Hardware address recognition
- DMAC hardware transmission handshake
- Hardware flow control
- Support single-line mode

## 1.15 Low power synchronous asynchronous receiver and transmitter **LPUART0~LPUART1**

2 Low Power Universal Asynchronous Receiver/Transmitter (LPUART0/LPUART1) that can work in low power mode.

LPUART basic functions:

- Transmission clock SCLK (SCLK can select XTL, RCL and PCLK)
- Transmit and receive data in system low power mode
- Half-duplex and full-duplex transmission
- 8/9-Bit transmission data length
- Hardware parity check
- 1/1.5/2-Bit stop bit
- Four different transmission modes
- 16-Bit baud rate generator
- Multi-machine communication
- Hardware address recognition
- DMAC hardware transmission handshake
- Hardware flow control
- Support single-line mode

## 1.16 Serial Peripheral Interface SPI

2 synchronous serial interface (Serial Peripheral Interface)

SPI basic features:

- Can be configured as a master or slave through programming
- Four-wire transmission mode, full-duplex communication
- 7 configurable baud rates in master mode
- The maximum division factor of master mode is PCLK/2, and the maximum communication rate is 16Mbps
- The maximum division factor of slave mode is PCLK/4, and the maximum communication rate is 12Mbps
- Configurable serial clock polarity and phase
- Interrupts support
- 8-bit data transmission, high bits are transmitted first and low bits later
- Support DMA software/hardware access

## 1.17 I2C Bus

2 I2C, using serial synchronous clock, can realize data transmission at different rates between devices.

I2C basic features:

- Supports four working modes: master send/receive, slave send/receive
- Supports three working rates: standard (100Kbps)/fast (400Kbps)/high speed (1Mbps)
- Supports 7-bit addressing function
- Supports noise filtering function
- Supports broadcast address
- Supports interrupt status query function

## 1.18 Audio Interface I2S

2 I2S audio communication interfaces

- Support Philips/MSB/LSB/PCM modes
- Support MCK output
- Support 5 audio sampling rates: 48, 44.1, 32, 16, 8 kHz
- Support 3 data lengths: 16, 24, 32 Bit
- Support 2 frame lengths: 16, 32 Bit
- Support DMA data transmission
- Support full-duplex transmission and reception (2 I2S cooperation)
- Support master transmission and reception
- Support slave transmission and reception

## 1.19 USB2.0 full speed module

The USB Full Speed (USBFS) controller provides a USB communication solution for portable devices. The USBFS controller supports device mode and has a full-speed PHY integrated inside the chip. The full-speed (FS, 12Mb/s) transceiver is supported in device mode. The USBFS controller supports all four transfer modes defined by the USB2.0 protocol (control transfer, bulk transfer, interrupt transfer, and isochronous transfer).

## 1.20 Controller Area Network CAN

The CAN communication interface module is equipped with 512 bytes of RAM for storing the sent and received data. It supports the CAN2.0B protocol specified in ISO11898-1 and the TTCAN protocol specified in ISO11898-4.

## 1.21 Crystal-less USB Clock Calibrator CTS

The clock calibration timer can adjust and calibrate the RCH48M clock frequency for use with Crystal-less USB. It can also adjust and calibrate the clock frequency of other RC oscillators, and can also be used as a general-purpose timer.

## 1.22 Buzzer

The 4 general-purpose timers and 2 low-power timers have multiplexed outputs to provide programmable drive frequencies for the buzzer. The buzzer port can provide 18mA of sink current, complementary output, and does not require additional transistors.

## 1.23 Clock Calibration Module CLKTRIM

Built-in clock calibration module, can calibrate the internal RC clock through the external accurate crystal clock, can also use the internal RC clock to check whether the external crystal clock is working properly.

Basic features of clock calibration:

- Calibration mode
- Monitoring mode
- 32-bit reference clock counter can load initial value
- 32-bit calibrated clock counter can configure overflow value
- 6 reference clock sources
- 6 calibrated clock sources
- Support interrupt mode

## 1.24 Device Electronic Signature

Each chip has a unique 10-byte device identification number before leaving the factory, including wafer lot information and chip coordinate information. The UID address is: 0x00100E74 - 0x00100E7D.

## 1.25 Cyclic Redundancy Check CRC

CRC16 complies with the polynomial  $x^{16} + x^{12} + x^5 + 1$  given in ISO/IEC13239.

CRC32 complies with the polynomial  $x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$  given in ISO/IEC13239.

## 1.26 Hardware Divider Module HDIV

HDIV (Hardware Divider) is a 32-bit signed/unsigned integer hardware divider.

Basic features of HDIV hardware divider:

- Configurable signed/unsigned integer division calculation

- 32-bit dividend, 16-bit divisor
- Output 32-bit quotient and 32-bit remainder
- Division by zero warning flag, division operation end flag
- 10 clock cycles to complete a division operation
- Writing the divisor register triggers the start of the division operation
- Automatically wait for the calculation to end when reading the quotient register/remainder register

## 1.27 Advanced Encryption Standard Module AES

AES (The Advanced Encryption Standard) is a new data encryption standard officially announced by the National Institute of Standards and Technology (NIST) on October 2, 2000. The block length of AES is fixed at 128 bits, and the key length supports 128/192/256 bits.

## 1.28 True Random Number Generator TRNG

TRNG is a true random number generator used to generate true random numbers.

## 1.29 Analog-to-Digital Converter ADC

12-bit successive approximation analog-to-digital converter with monotonicity and no missing codes. The sampling rate reaches 1Msps when working at 24MHz ADC clock. The reference voltage can be selected from the on-chip precision voltage (1.5V or 2.5V) or from the external input or power supply voltage. 40 input channels, including 36 external pin inputs, 1 internal temperature sensor voltage, 1 1/3 power supply voltage, and 2 DAC outputs. Built-in configurable input signal amplifier to detect high output impedance signals.

SAR ADC basic features:

- 12-bit conversion accuracy
- 1Msps conversion speed
- 40 input channels, including 36 external pin inputs, 1 internal temperature sensor voltage, 1 1/3 AVCC voltage, 2 DAC outputs
- 4 reference sources: AVCC voltage, ExRef pin, built-in 1.5V reference voltage, built-in 2.5V reference voltage
- ADC voltage input range: 0~Vref
- 4 conversion modes: single conversion, sequential scan continuous conversion, queue scan continuous conversion, continuous conversion accumulation
- Input channel voltage threshold monitoring
- Software configurable ADC conversion rate
- Built-in signal amplifier, can convert high-impedance signals
- Support on-chip external devices to automatically trigger ADC conversion, effectively reduce chip power consumption and improve the real-time performance of conversion

## 1.30 Digital-to-Analog Converter DAC

2-channel 12Bit 500Ksps DAC, capable of digital-to-analog conversion.

## 1.31 Analog Comparator VC

Built-in 3 VCs, chip pin voltage monitoring/comparison circuits. 16 configurable positive external input channels, 11 configurable negative external input channels; 4 internal negative input channels, including 1 internal temperature sensor voltage, 1 built-in BGR 2.5V reference voltage, and 1 64-stage resistor divider. VC output can be used for general timer TIM0/1/2/3, low power timer LPTIM and programmable counter array PCA capture, gating, and external counting clock. Asynchronous interrupts can be generated based on rising/falling edges to wake up the MCU from low power mode. Configurable software anti-shake function.

## 1.32 Low Voltage Detector LVD

Detect the chip power supply voltage or chip pin voltage. 16-level voltage monitoring value (1.8 ~ 3.3V). Asynchronous interrupt or reset can be generated according to the rising/falling edge. With hardware hysteresis circuit and configurable software anti-shake function.

LVD basic features:

- 4 monitoring sources, AVCC, PC13, PB08, PB07;
- 16-level threshold voltage, 1.8~3.3V optional;
- 8 trigger conditions, high level, rising edge, falling edge combination;
- 2 trigger results, reset, interrupt;
- 8-level filter configuration to prevent false triggering;
- Hysteresis function, strong anti-interference.

## 1.33 Operational Amplifier OPA

OPA0/ 1/ 2 modules can be flexibly configured and are suitable for simple filter and buffer applications. The OPA3/4 module can be used as a DAC buffer or configured as an op amp.

## 1.34 Liquid Crystal Controller LCD

Note: Only for HC32L073 series.

The LCD controller is a digital controller/driver for monochrome passive liquid crystal displays (LCDs) with up to 8 common terminals (COM) and 48 segment terminals (SEG) to drive 208 (4x52) or 384 (8x48) LCD picture elements. Capacitive or resistive voltage division can be selected, and internal resistor voltage division is supported. Internal resistor voltage division can adjust the contrast. Supports DMA hardware data transfer.

LCD Basic Features:

- Highly flexible frame rate control
- Supports static, 1/2, 1/3, 1/4, 1/6 and 1/8 duty cycles

- Supports 1/2, 1/3 bias
- LCD data RAM with up to 16 registers
- LCD contrast can be configured by software
- 3 drive waveform generation methods: internal resistor voltage division, external resistor voltage division, external capacitor voltage division.  
The power consumption of the internal resistor voltage division method can be configured by software to match the capacitor charge required by the LCD panel.
- Supports low power mode: LCD controller can display in Active, Sleep, DeepSleep mode
- Configurable frame interrupt
- Support LCD flashing function and configurable multiple flashing frequencies
- Unused LCD segments and common pins can be configured as digital or analog functions

## 1.35 Embedded Debug System

Embedded debugging solution, providing a full-featured real-time debugger, with standard and mature Keil/IAR debugging and development software. Supports 4 hard breakpoints and multiple soft breakpoints.

## 1.36 Programming Modes

Supports two programming modes: online programming and offline programming.

Supports two programming protocols: ISP protocol and SWD protocol.

Supports unified programming interface: ISP protocol and SWD protocol share SWD port.

When reset, BOOT0 (PF11) pin is high level, the chip works in ISP programming mode, and FLASH can be programmed through ISP.

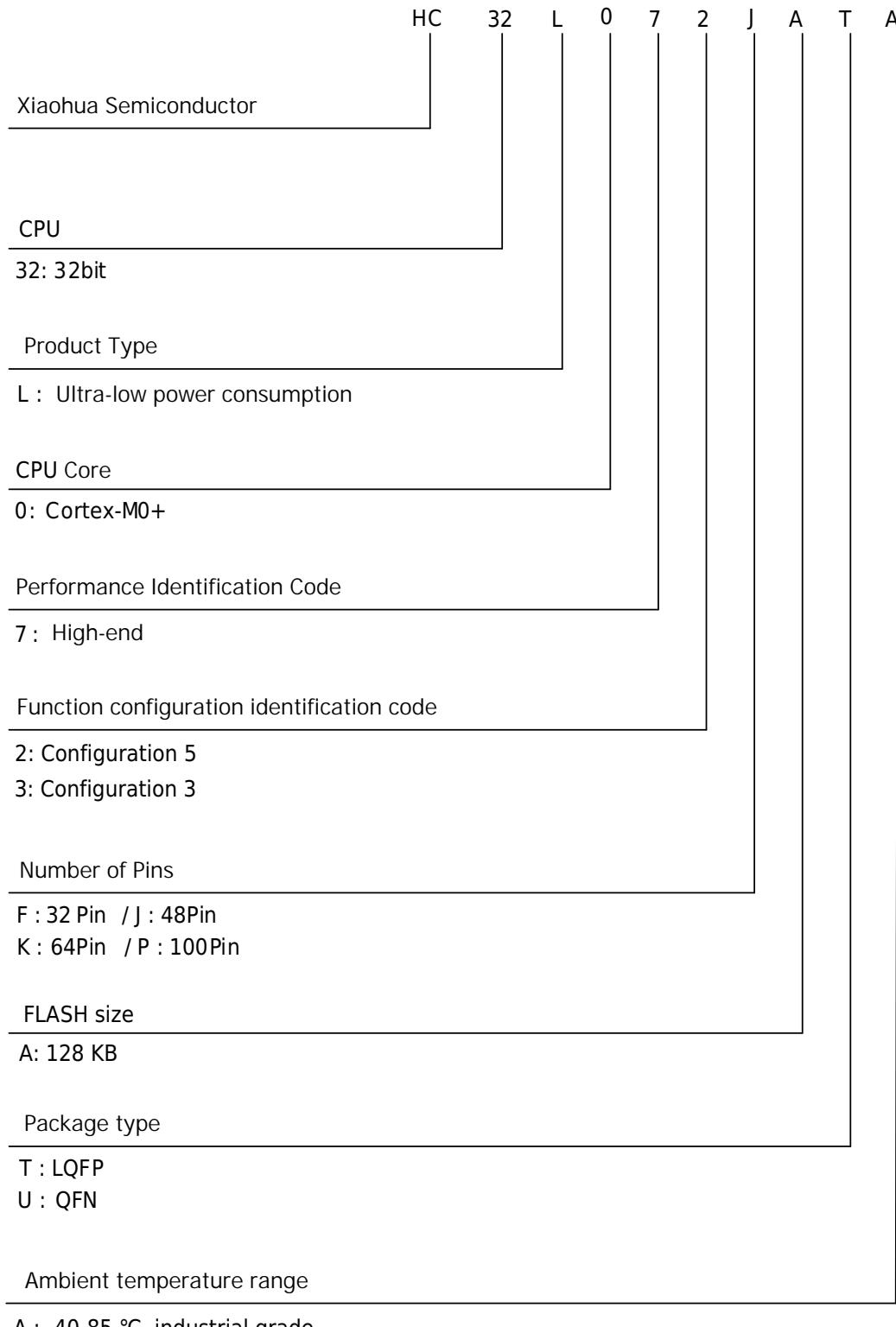
When reset, BOOT0 (PF11) pin is low level, the chip works in user mode, the chip executes the program code in FLASH, and Flash can be programmed through SWD protocol.

## 1.37 Security

Encrypted embedded debugging solution with full-featured real-time debugger.

## 2 Product Lineup

### 2.1 Product Naming



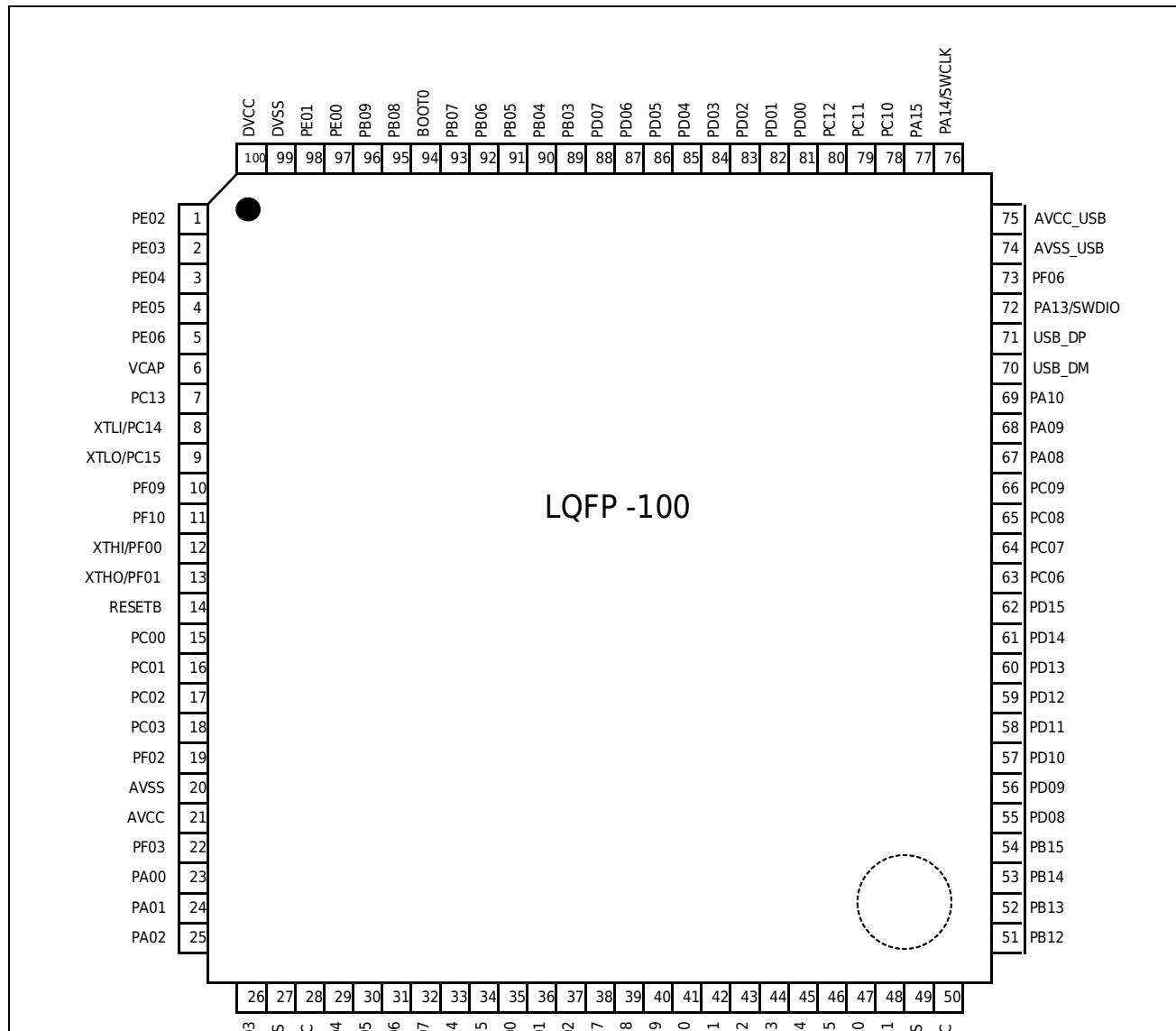
## 2.2 Functionality

Product Name	L072PATA	L073PATA	L072KATA	L073KATA	L072JATA	L073JATA	L072FAUA						
Number of Pins	100		64		48		32						
GPIO pins	86		50	52	36	38	22						
CPU	Core	Cortex M0+											
	Frequency	48MHz											
Power supply voltage range	1.8 ~5.5V												
Temperature rang	-40 ~ 85°C												
Debug function	SWD debug interface												
Unique identification code	Support												
通信接口	UART0/1/2/3 LPUART0/1 SPI0/1 I2C0/1 I2S0/1			UART0/1 LPUART0/1 SPI0/1 I2C0/1 I2S0/1		UART0/1 LPUART0 SPI0 I2C0 I2S0							
Communication interfaces	General purpose timer TIM0/1/2/3 Advanced timer TIM4/5/6 Low power timer LPTIMO/1												
12-bit A/D converter	24ch		23ch		17ch		10ch						
12-bit D/A converter	2ch		2ch		2ch		2ch						
Analog voltage comparator	VC0/1/2												
Operational amplifier	5		5		3		1						
USB	Support		Support	Not support	Support	Not support	Support						
CAN	Support												
Real-time clock	Support												
Port interrupt	86	50	52	36	38	22							
Low voltage detection reset	1												
Clock	Internal high speed oscillator	RCH 4/8/16/22.12/24MHz											
	Internal low speed oscillator	RCL 32.8/38.4kHz											
	PLL	8~48MHz											
	External high speed crystal	8~32MHz											
Buzzer	Max 6ch												
Flash Security Protection	Support												
RAM Parity	Support												

## 3 Pin Configuration and Function

### 3.1 Pin Configuration Diagram

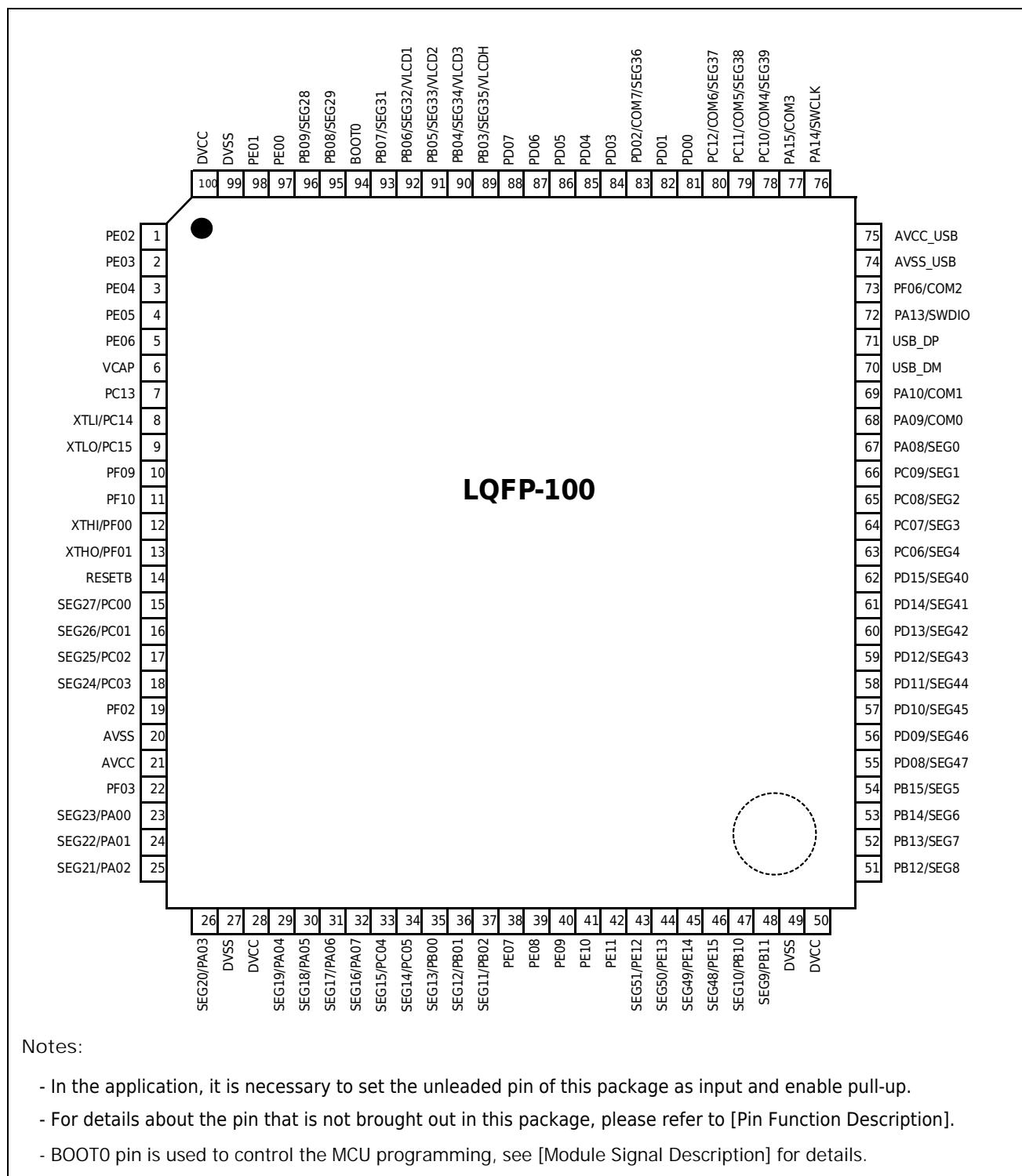
**HC32L072PATA**



Notes:

- In the application, it is necessary to set the unlead pin of this package as input and enable pull-up.
- For details about the pin that is not brought out in this package, please refer to [Pin Function Description].
- BOOT0 pin is used to control the MCU programming, see [Module Signal Description] for details.

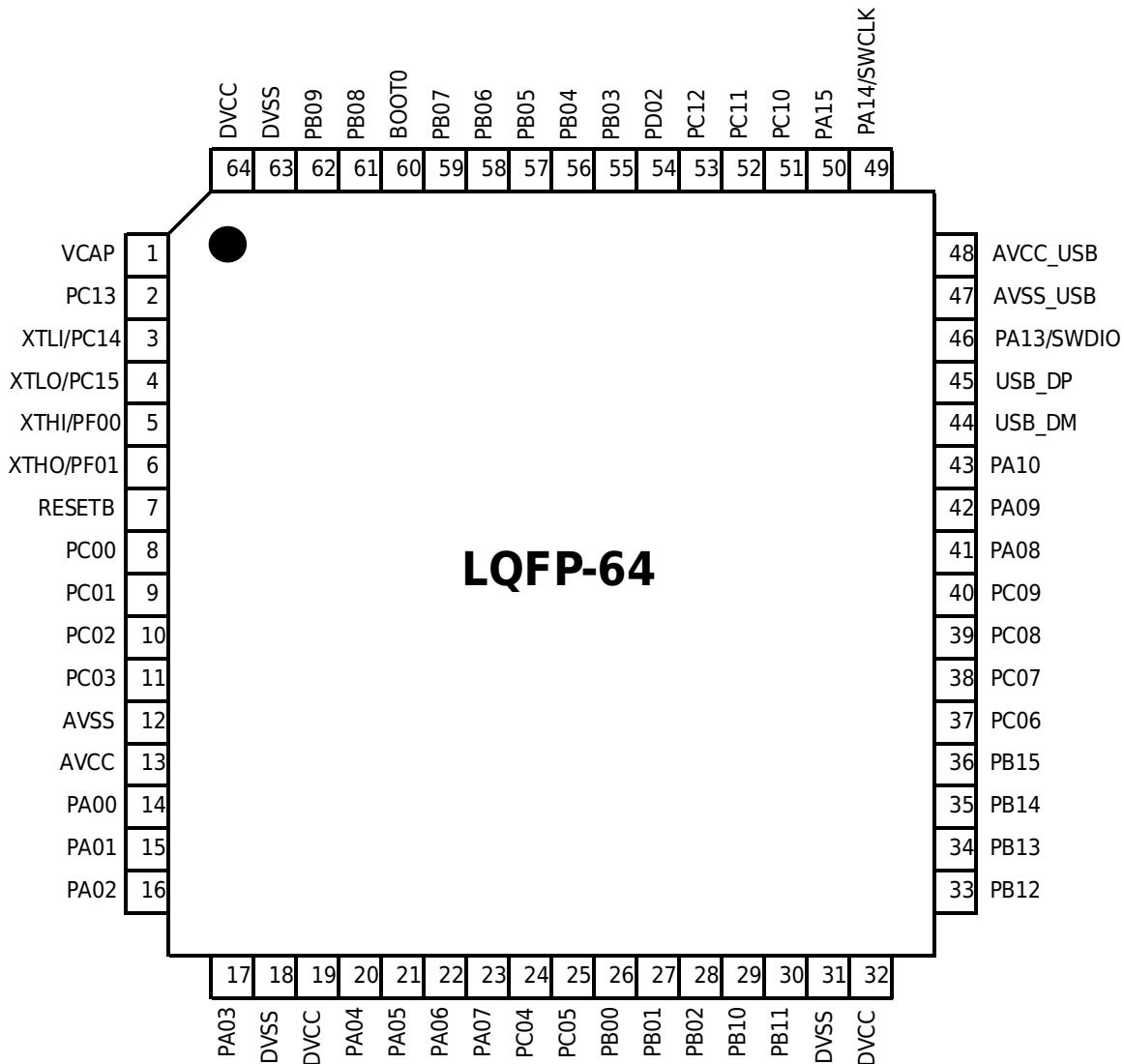
HC32L073PATA



#### Notes:

- In the application, it is necessary to set the unleaded pin of this package as input and enable pull-up.
  - For details about the pin that is not brought out in this package, please refer to [Pin Function Description].
  - BOOT0 pin is used to control the MCU programming, see [Module Signal Description] for details.

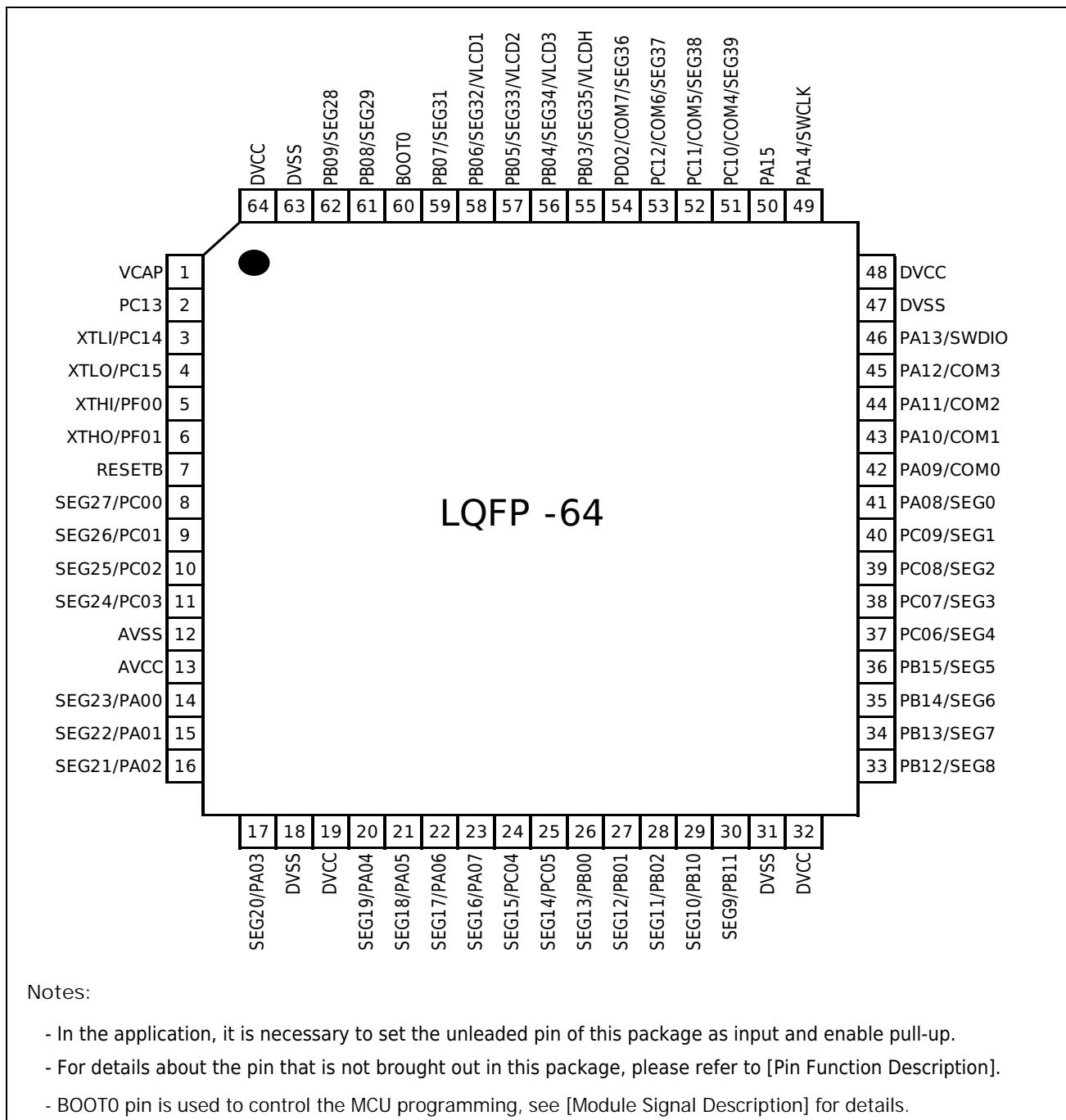
## HC32L072KATA



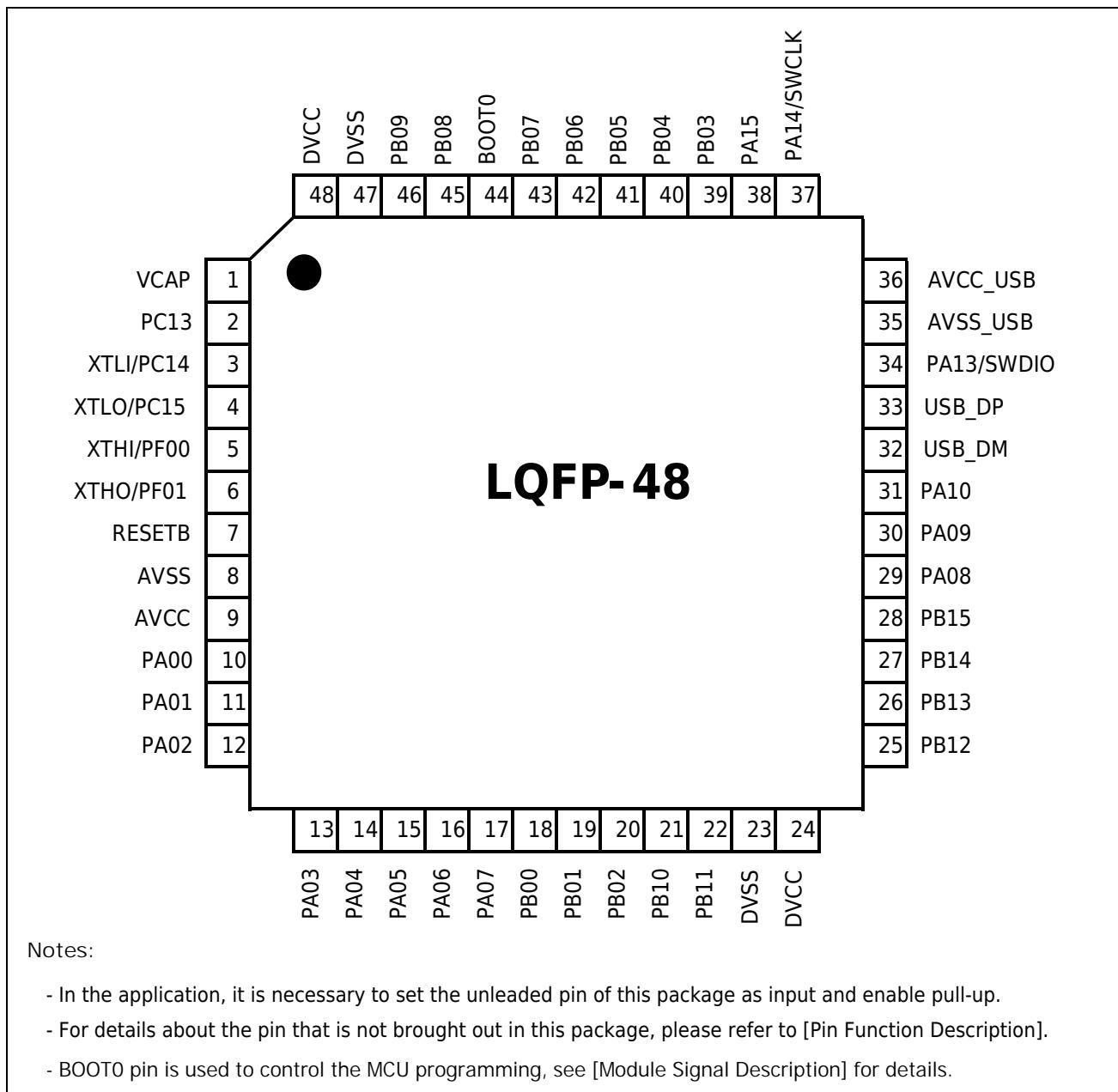
Notes:

- In the application, it is necessary to set the unlead pin of this package as input and enable pull-up.
- For details about the pin that is not brought out in this package, please refer to [Pin Function Description].
- BOOT0 pin is used to control the MCU programming, see [Module Signal Description] for details.

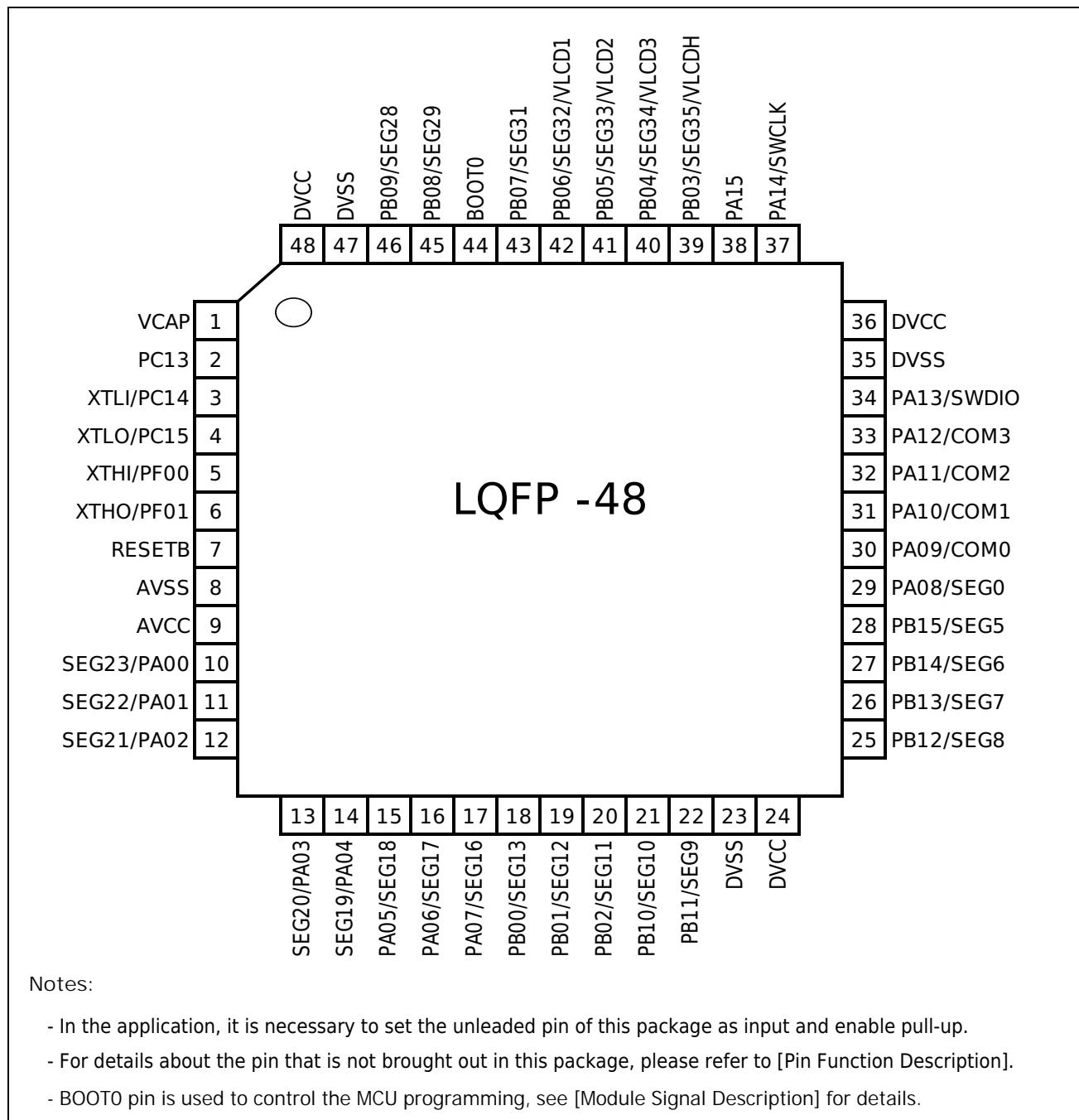
## HC32L073KATA



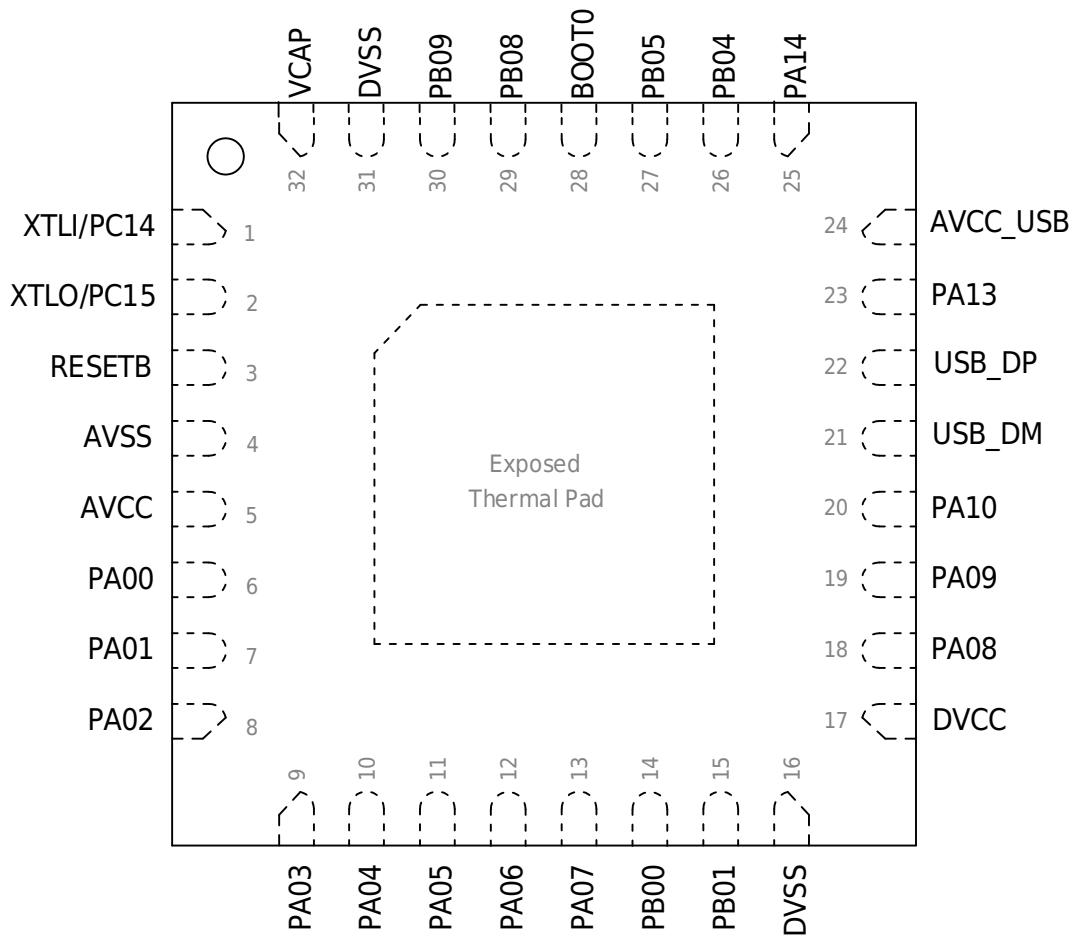
## HC32L072JATA



HC32L073JATA



## HC32L072FAUA



Notes:

- In the application, it is necessary to set the unlead pin of this package as input and enable pull-up.
- For details about the pin that is not brought out in this package, please refer to [Pin Function Description].
- BOOT0 pin is used to control the MCU programming, see [Module Signal Description] for details.

**Figure 3-1 Pin Configuration**

### 3.2 Pin Function Description

LQFP100	LQFP64	LQFP48	QFN32	NAME	DIGITAL	ANALOG
1				PE02	PCA_ECI	
2				PE03	PCA_CH0	
3				PE04	PCA_CH1	
4				PE05	PCA_CH2	
5				PE06	PCA_CH3	
6	1	1	32	VCAP		
7	2	2		PC13	RTC_1HZ TIM3_CH1B I2S0_SCK	LVD0
8	3	3	1	PC14		XTLI
9	4	4	2	PC15		XTLO
10				PF09	TIM0_CHA	
11				PF10	TIM0_CHB	
12	5	5		PF00	I2C0_SDA CRS_SYNC UART1_TXD	XTHI
13	6	6		PF01	I2C0_SCL UART1_RXD	XTHO
14	7	7	3	RESETB		
15	8			PC00	LPTIMO_GATE PCNT_S0 UART1_CTS UART2_RTS I2S0_MCK	AIN10, VC0_INP0 VC1_INN0 SEG27
16	9			PC01	LPTIMO_TOG TIM5_CHB UART1_RTS PCNT_S0FO UART2_CTS I2S0_SD	AIN11 VC0_INP1 VC1_INN1 SEG26
17	10			PC02	SPI1_MISO LPTIMO_TOGN PCNT_S1 UART2_RXD	AIN12, VC0_INP2 VC1_INN2 SEG25
18	11			PC03	SPI1_MOSI LPTIMO_EXT LPTIMO_TOGN PCNT_S1FO UART2_TXD	AIN13 VC0_INP3 VC1_INN3 SEG24
19				PF02		
20	12	8	4	AVSS		
21	13	9	5	AVCC		
22				PF03		
23	14	10	6	PA00	UART1_CTS LPUART1_RXD TIM0_ETR VC0_OUT TIM1_CHA TIM3_ETR TIM0_CHA	AIN0 VC0_INP4 VC0_INN0 VC1_INP0 VC1_INN4 SEG23

LQFP100	LQFP64	LQFP48	QFN32	NAME	DIGITAL	ANALOG
24	15	11	7	PA01	UART1_RTS LPUART1_RXD TIM0_CHB TIM1_ETR TIM1_CHB HCLK_OUT SPI1_MOSI	AIN1 VC0_INP5 VC0_INN1 VC1_INP1 VC1_INN5 SEG22
25	16	12	8	PA02	UART1_TXD TIM0_CHA VC1_OUT TIM1_CHA TIM2_CHA PCLK_OUT SPI1_MISO	AIN2 VC0_INP6 VC0_INN2 VC1_INP2 SEG21
26	17	13	9	PA03	UART1_RXD TIM0_GATE TIM1_CHB TIM2_CHB SPI1_CS TIM3_CH1A TIM5_CHA	AIN3 VC0_INP7 VC0_INN3 VC1_INP3 SEG20
27	18			DVSS		
28	19			DVCC		
				PF04		
				PF05		
29	20	14	10	PA04	SPI0_CS UART1_TXD PCA_CH4 TIM2_ETR TIM5_CHA LVD_OUT TIM3_CH2B	AIN4 VC0_INP8 VC0_INN4 VC1_INP4 OP3_OUT DAC0_OUT SEG19
30	21	15	11	PA05	SPI0_SCK TIM0_ETR PCA_ECI TIM0_CHA TIM5_CHB XTL_OUT XTH_OUT	AIN5 VC0_INP9 VC0_INN5 VC1_INP5 VC2_INP0 VC2_INN0 OP4_OUT DAC1_OUT SEG18
31	22	16	12	PA06	SPI0_MISO PCA_CH0 TIM3_BK TIM1_CHA VC0_OUT TIM3_GATE LPUART0_CTS	AIN6 VC0_INP10 VC0_INN6 OP4_INN SEG17
32	23	17	13	PA07	SPI0_MOSI PCA_CH1 HCLK_OUT TIM3_CH0B TIM2_CHA VC1_OUT TIM4_CHB	AIN7 VC0_INP11 VC0_INN7 OP4_INP SEG16
33	24			PC04	LPUART0_RXD TIM2_ETR IR_OUT VC2_OUT I2SO_WS	AIN14 VC0_INN8 SEG15

LQFP100	LQFP64	LQFP48	QFN32	NAME	DIGITAL	ANALOG
34	25			PC05	LPUART0_RXD TIM6_CHB PCA_CH4 I2S0_SDIN	AIN15 VC0_INN9 OP3_INN SEG14
35	26	18	14	PB00	PCA_CH2 TIM3_CH1B LPUART0_TXD TIM5_CHB RCH_OUT RCL_OUT PLL_OUT	AIN8 VC1_INN6 OP3_INP SEG13
36	27	19	15	PB01	PCA_CH3 PCLK_OUT TIM3_CH2B TIM6_CHB LPUART0_RTS VC2_OUT TCLK_OUT	AIN9/EXVREF VC1_INP6 VC1_INN7 VC2_INP1 VC2_INN1 SEG12
37	28	20		PB02	LPTIM0_TOG PCA_ECI LPUART1_TXD TIM4_CHA TIM1_BK TIM0_BK TIM2_BK	AIN16, VC1_INP7 VC1_INN8 OP2_INN SEG11
38				PE07	TIM3_ETR LPTIM1_GATE	
39				PE08	TIM3_CH0B LPTIM1_EXT	OP2_OUT4
40				PE09	TIM3_CH0A LPTIM1_TOG	VC2_INP2 OP2_OUT3
41				PE10	TIM3_CH1B LPTIM1_TOGN	VC2_INP3 OP2_OUT2
42				PE11	TIM3_CH1A	VC2_INP4 VC2_INN2 OP2_OUT1
43				PE12	TIM3_CH2B SPI0_CS UART3_CTS	OP1_OUT4 SEG51
44				PE13	TIM3_CH2A SPI0_SCK UART3_RTS	VC2_INP5 OP1_OUT3 SEG50
45				PE14	TIM3_CH0B SPI0_MISO UART3_RXD	VC2_INP6 OP1_OUT2 SEG49
46				PE15	TIM3_BK SPI0_MOSI UART3_TXD	AIN23, VC2_INP7 VC2_INN3 OP1_OUT1 SEG48
47	29	21		PB10	I2C1_SCL SPI1_SCK TIM1_CHA LPUART0_TXD TIM3_CH1A LPUART1_RTS UART1_RTS	AIN17, VC1_INP8 OP2_INP SEG10
48	30	22		PB11	I2C1_SDA TIM1_CHB LPUART0_RXD TIM2_GATE TIM6_CHA	AIN18, VC2_INP8 VC2_INN4 OP2_OUT SEG9

LQFP100	LQFP64	LQFP48	QFN32	NAME	DIGITAL	ANALOG
					LPUART1_CTS UART1_CTS	
49	31	23	16	DVSS		
50	32	24	17	DVCC		
51	33	25		PB12	SPI1_CS TIM3_BK LPUART0_RXD TIM0_BK LPUART0_RTS TIM6_CHA	AIN19 VC1_INP9 OP1_INN SEG8
52	34	26		PB13	SPI1_SCK I2C1_SCL TIM3_CH0B LPUART0_CTS TIM1_CHA TIM1_GATE TIM6_CHB	AIN20 VC1_INP10 OP1_INP SEG7
53	35	27		PB14	SPI1_MISO I2C1_SDA TIM3_CH1B TIM0_CHA RTC_1HZ LPUART0_RTS TIM1_BK	AIN21, VC1_INP11 VC2_INP9 VC2_INN5 OP1_OUT SEG6
54	36	28		PB15	SPI1_MOSI TIM3_CH2B TIM0_CHB TIM0_GATE LPUART1_RXD	AIN22, OP0_INN SEG5
55				PD08	LPUART0_RXD I2S0_SCK	OP0_OUT4 SEG47
56				PD09	LPUART0_RXD I2S0_MCK	VC2_INP10 OP0_OUT3 SEG46
57				PD10	LPUART0_RXD I2S0_SD	VC2_INP11 VC2_INN6 OP0_OUT2 SEG45
58				PD11	LPUART0_CTS I2S0_WS	VC2_INP12 VC2_INN7 OP0_OUT1 SEG44
59				PD12	LPUART0_RTS UART2_RTS	SEG43
60				PD13	UART2_RXD I2S0_SDIN	SEG42
61				PD14	UART2_TXD	SEG41
62				PD15	CRS_SYNC UART2_CTS	SEG40
63	37			PC06	PCA_CH0 TIM4_CHA TIM2_CHA LPTIM1_GATE UART3_RXD I2S1_SCK	OP0_INP SEG4
64	38			PC07	PCA_CH1 TIM5_CHA TIM2_CHB LPTIM1_EXT UART3_TXD I2S1_MCK	VC2_INP13 VC2_INN8 OP0_OUT SEG3

LQFP100	LQFP64	LQFP48	QFN32	NAME	DIGITAL	ANALOG
65	39			PC08	PCA_CH2 TIM6_CHA TIM2_ETR LPTIM1_TOG UART3_CTS I2S1_SD	SEG2
66	40			PC09	PCA_CH3 TIM4_CHB TIM1_ETR LPTIM1_TOGN UART3_RTS I2S1_WS	SEG1
67	41	29	18	PA08	UART0_RXD TIM3_CH0A CRS_SYNC CAN_STBY TIM1_GATE TIM4_CHA TIM3_BK	SEG0
68	42	30	19	PA09	UART0_RXD TIM3_CH1A TIM0_BK I2C0_SCL HCLK_OUT TIM5_CHA	COM0
69	43	31	20	PA10	UART0_RXD TIM3_CH2A TIM2_BK I2C0_SDA TIM2_GATE PCLK_OUT TIM6_CHA	COM1
	44 (L073)	32 (L073)		PA11	UART0_CTS TIM3_GATE I2C1_SCL CAN_RX VC0_OUT SPI0_MISO TIM4_CHB	COM2
	45 (L073)	33 (L073)		PA12	UART0_RTS TIM3_ETR I2C1_SDA CAN_TX VC1_OUT SPI0_MOSI PCNT_SO	COM3
70	44 (L072)	32 (L072)	21	USBDM		
71	45 (L072)	33 (L072)	22	USBDP		
72	46	34	23	PA13	IR_OUT UART0_RXD LVD_OUT TIM3_ETR RTC_1HZ PCNT_S1 VC2_OUT	SWDIO
73				PF06	I2C1_SCL LPUART1_CTS UART0_CTS	COM2
				PF07	I2C1_SDA LPUART1_RTS UART0_RTS	
	47 (L073)	35 (L073)		DVSS		

LQFP100	LQFP64	LQFP48	QFN32	NAME	DIGITAL	ANALOG
	48 (L073)	36 (L073)		DVCC		
74	47 (L072)	35 (L072)		AVSS_USB		
75	48 (L072)	36 (L072)	24	AVCC_USB		
76	49	37	25	PA14	UART1_TXD UART0_TXD TIM3_CH2A LVD_OUT RCH_OUT RCL_OUT PLL_OUT	SWCLK
77	50	38		PA15	SPI0_CS UART1_RXD LPUART1_RTS TIM0_ETR TIM0_CHA TIM3_CH1A	COM3
78	51			PC10	LPUART1_RXD LPUART0_RXD PCA_CH2	COM4/ SEG39
79	52			PC11	LPUART1_RXD LPUART0_RXD PCA_CH3 PCNT_SOFO	COM5/ SEG38
80	53			PC12	LPUART0_RXD LPUART1_RXD PCA_CH4 PCNT_S1FO	COM6/ SEG37
81				PD00	CAN_RX SPI1_CS	
82				PD01	CAN_TX SPI1_SCK	
83	54			PD02	PCA_ECI LPUART0_RTS TIM1_ETR	COM7/ SEG36
84				PD03	UART1_CTS SPI1_MISO LPTIM1_TOG I2S1_SCK	
85				PD04	UART1_RTS SPI1_MOSI LPTIM1_TOGN I2S1_MCK	
86				PD05	UART1_RXD LPTIM1_GATE CAN_STBY I2S1_SD	
87				PD06	UART1_RXD LPTIM1_EXT I2S1_WS	
88				PD07	UART1_RXD I2S1_SDIN	
89	55	39		PB03	SPI0_SCK TIM0_CHB TIM1_GATE TIM3_CH0A LPTIM0_GATE XTL_OUT XTH_OUT	VC1_INN9 SEG35/VLCDH
90	56	40	26	PB04	SPI0_MISO PCA_CH0 TIM2_BK	VC0_INP12 VC1_INP12 SEG34/VLCD3

LQFP100	LQFP64	LQFP48	QFN32	NAME	DIGITAL	ANALOG
					UART0_CTS TIM2_GATE TIM3_CH0B LPTIM0_EXT	
91	57	41	27	PB05	SPI0_MOSI TIM1_BK PCA_CH1 LPTIM0_GATE PCNT_S0 UART0_RTS	VC0_INP13 SEG33/ VLCD2
92	58	42		PB06	I2C0_SCL UART0_RXD TIM1_CHB TIM0_CHA LPTIM0_EXT TIM3_CH0A LPTIM0_TOG	VC0_INP14 VC1_INP14 SEG32/ VLCD1
93	59	43		PB07	I2C0_SDA UART0_RXD TIM2_CHB LPUART1_CTS TIM0_CHB LPTIM0_TOGN PCNT_S1	VC1_INP15 LVD2 SEG31
94	60	44	28	BOOT0/PF11		SEG30
95	61	45	29	PB08	I2C0_SCL TIM1_CHA CAN_RX TIM2_CHA TIM0_GATE TIM3_CH2A UART0_RXD	LVD1 SEG29
96	62	46	30	PB09	I2C0_SDA IR_OUT SPI1_CS TIM2_CHA CAN_TX TIM2_CHB UART0_RXD	SEG28
97				PE00	TIM1_CHA	
98				PE01	TIM2_CHA	
99	63	47	31	DVSS		
100	64	48		DVCC		

The digital function of each pin is controlled by the PSEL bit field, see the table below for details.

PxSEL							
0	1	2	3	4	5	6	7
PA00	UART1_CTS	LPUART1_TXD	TIM0_ETR	VC0_OUT	TIM1_CHA	TIM3_ETR	TIM0_CHA
PA01	UART1_RTS	LPUART1_RXD	TIM0_CHB	TIM1_ETR	TIM1_CHB	HCLK_OUT	SPI1_MOSI
PA02	UART1_TXD	TIM0_CHA	VC1_OUT	TIM1_CHA	TIM2_CHA	PCLK_OUT	SPI1_MISO
PA03	UART1_RXD	TIM0_GATE	TIM1_CHB	TIM2_CHB	SPI1_CS	TIM3_CH1A	TIM5_CHA
PA04	SPI0_CS	UART1_TXD	PCA_CH4	TIM2_ETR	TIM5_CHA	LVD_OUT	TIM3_CH2B
PA05	SPI0_SCK	TIM0_ETR	PCA_ECI	TIM0_CHA	TIM5_CHB	XTL_OUT	XTH_OUT
PA06	SPI0_MISO	PCA_CH0	TIM3_BK	TIM1_CHA	VC0_OUT	TIM3_GATE	LPUART0_CTS
PA07	SPI0_MOSI	PCA_CH1	HCLK_OUT	TIM3_CH0B	TIM2_CHA	VC1_OUT	TIM4_CHB
PA08	UART0_TXD	TIM3_CH0A	CRS_SYNC	CAN_STBY	TIM1_GATE	TIM4_CHA	TIM3_BK
PA09	UART0_TXD	TIM3_CH1A	TIM0_BK	I2C0_SCL		HCLK_OUT	TIM5_CHA
PA10	UART0_RXD	TIM3_CH2A	TIM2_BK	I2C0_SDA	TIM2_GATE	PCLK_OUT	TIM6_CHA
PA11	UART0_CTS	TIM3_GATE	I2C1_SCL	CAN_RX	VC0_OUT	SPI0_MISO	TIM4_CHB
PA12	UART0_RTS	TIM3_ETR	I2C1_SDA	CAN_TX	VC1_OUT	SPI0_MOSI	PCNT_SO
PA13	IR_OUT	UART0_RXD	LVD_OUT	TIM3_ETR	RTC_1HZ	PCNT_S1	VC2_OUT
PA14	UART1_TXD	UART0_TXD	TIM3_CH2A	LVD_OUT	RCH_OUT	RCL_OUT	PLL_OUT
PA15	SPI0_CS	UART1_RXD	LPUART1_RTS	TIM0_ETR	TIM0_CHA	TIM3_CH1A	
PB00	PCA_CH2	TIM3_CH1B	LPUART0_TXD	TIM5_CHB	RCH_OUT	RCL_OUT	PLL_OUT
PB01	PCA_CH3	PCLK_OUT	TIM3_CH2B	TIM6_CHB	LPUART0_RTS	VC2_OUT	TCLK_OUT
PB02	LPTIMO_TOG	PCA_ECI	LPUART1_TXD	TIM4_CHA	TIM1_BK	TIM0_BK	TIM2_BK
PB03	SPI0_SCK	TIM0_CHB	TIM1_GATE	TIM3_CH0A	LPTIMO_GATE	XTL_OUT	XTH_OUT
PB04	SPI0_MISO	PCA_CH0	TIM2_BK	UART0_CTS	TIM2_GATE	TIM3_CH0B	LPTIMO_EXT
PB05	SPI0_MOSI		TIM1_BK	PCA_CH1	LPTIMO_GATE	PCNT_SO	UART0_RTS
PB06	I2C0_SCL	UART0_TXD	TIM1_CHB	TIM0_CHA	LPTIMO_EXT	TIM3_CH0A	LPTIMO_TOG
PB07	I2C0_SDA	UART0_RXD	TIM2_CHB	LPUART1_CTS	TIM0_CHB	LPTIMO_TOGN	PCNT_S1
PB08	I2C0_SCL	TIM1_CHA	CAN_RX	TIM2_CHA	TIM0_GATE	TIM3_CH2A	UART0_TXD
PB09	I2C0_SDA	IR_OUT	SPI1_CS	TIM2_CHA	CAN_TX	TIM2_CHB	UART0_RXD
PB10	I2C1_SCL	SPI1_SCK	TIM1_CHA	LPUART0_TXD	TIM3_CH1A	LPUART1_RTS	UART1_RTS
PB11	I2C1_SDA	TIM1_CHB	LPUART0_RXD	TIM2_GATE	TIM6_CHA	LPUART1_CTS	UART1_CTS
PB12	SPI1_CS	TIM3_BK	LPUART0_TXD	TIM0_BK		LPUART0_RTS	TIM6_CHA
PB13	SPI1_SCK	I2C1_SCL	TIM3_CH0B	LPUART0_CTS	TIM1_CHA	TIM1_GATE	TIM6_CHB
PB14	SPI1_MISO	I2C1_SDA	TIM3_CH1B	TIM0_CHA	RTC_1HZ	LPUART0_RTS	TIM1_BK
PB15	SPI1_MOSI	TIM3_CH2B	TIM0_CHB	TIM0_GATE			LPUART1_RXD
PC00	LPTIMO_GATE	PCNT_SO	UART1_CTS	UART2_RTS	I2S0_MCK		
PC01	LPTIMO_TOG	TIM5_CHB	UART1_RTS	PCNT_S0FO	I2S0_SD	UART2_CTS	
PC02	SPI1_MISO	LPTIMO_TOGN	PCNT_S1	UART2_RXD			
PC03	SPI1_MOSI	LPTIMO_EXT	LPTIMO_TOGN	PCNT_S1FO	UART2_TXD		

PxSEL							
0	1	2	3	4	5	6	7
PC04	LPUART0_TXD	TIM2_ETR	IR_OUT	VC2_OUT	I2S0_WS		
PC05	LPUART0_RXD	TIM6_CHB	PCA_CH4		I2S0_SDIN		
PC06	PCA_CH0	TIM4_CHA	TIM2_CHA	LPTIM1_GATE	I2S1_SCK	UART3_RXD	
PC07	PCA_CH1	TIM5_CHA	TIM2_CHB	LPTIM1_EXT	I2S1_MCK	UART3_TXD	
PC08	PCA_CH2	TIM6_CHA	TIM2_ETR	LPTIM1_TOG	I2S1_SD	UART3_CTS	
PC09	PCA_CH3	TIM4_CHB	TIM1_ETR	LPTIM1_TOGN	I2S1_WS	UART3_RTS	
PC10	LPUART1_TXD	LPUART0_RXD	PCA_CH2				
PC11	LPUART1_RXD	LPUART0_RXD	PCA_CH3	PCNT_S0FO			
PC12	LPUART0_RXD	LPUART1_RXD	PCA_CH4	PCNT_S1FO			
PC13		RTC_1HZ	TIM3_CH1B		I2S0_SCK		
PC14							
PC15							
PD00	CAN_RX	SPI1_CS					
PD01	CAN_TX	SPI1_SCK					
PD02	PCA_ECI	LPUART0_RTS	TIM1_ETR				
PD03	UART1_CTS	SPI1_MISO	LPTIM1_TOG	I2S1_SCK			
PD04	UART1_RTS	SPI1_MOSI	LPTIM1_TOGN	I2S1_MCK			
PD05	UART1_RXD	LPTIM1_GATE	CAN_STBY	I2S1_SD			
PD06	UART1_RXD	LPTIM1_EXT		I2S1_WS			
PD07	UART1_RXD			I2S1_SDIN			
PD08	LPUART0_RXD	I2S0_SCK					
PD09	LPUART0_RXD	I2S0_MCK					
PD10	LPUART0_RXD	I2S0_SD					
PD11	LPUART0_CTS	I2S0_WS					
PD12	LPUART0_RTS	UART2_RTS					
PD13	UART2_RXD	I2S0_SDIN					
PD14	UART2_RXD						
PD15	CRS_SYNC	UART2_CTS					
PE00	TIM1_CHA						
PE01	TIM2_CHA						
PE02	PCA_ECI						
PE03	PCA_CH0						
PE04	PCA_CH1						
PE05	PCA_CH2						
PE06	PCA_CH3						
PE07	TIM3_ETR	LPTIM1_GATE					
PE08	TIM3_CH0B	LPTIM1_EXT					

PxSEL							
<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
PE09	TIM3_CH0A	LPTIM1_TOG					
PE10	TIM3_CH1B	LPTIM1_TOGN					
PE11	TIM3_CH1A						
PE12	TIM3_CH2B	SPI0_CS	UART3_CTS				
PE13	TIM3_CH2A	SPI0_SCK	UART3_RTS				
PE14	TIM3_CH0B	SPI0_MISO	UART3_RXD				
PE15	TIM3_BK	SPI0_MOSI	UART3_TXD				
PF00	I2C0_SDA	CRS_SYNC	UART1_TXD				
PF01	I2C0_SCL		UART1_RXD				
PF02							
PF03							
PF04							
PF05							
PF06	I2C1_SCL	LPUART1_CTS	UART0_CTS				
PF07	I2C1_SDA	LPUART1_RTS	UART0_RTS				
PF09	TIM0_CHA						
PF10	TIM0_CHB						
PF11							

### 3.3 Module signal description

**Table 3-1 Module signal description**

Module	Pin Name	Description
Power supply	DVCC	Digital power supply
	AVCC	Analog power supply
	DVSS	Digital ground
	AVSS	Analog ground
	AVCC_USB	USB module power supply (not more than 3.6V, see [Electrical Characteristics] for details)
	AVSS_USB	USB module ground
	VCAP	LDO core power supply output (for internal circuit use only, external decoupling capacitor of not less than 1uF is required)
ISP	BOOT0	When reset, the BOOT0 (PF11) pin is high, the chip works in ISP programming mode, and the FLASH can be programmed through the ISP protocol. When reset, the BOOT0 (PF11) pin is low, the chip works in user mode, the chip executes the program code in the FLASH, and the FLASH can be programmed through the SWD protocol.
ADC	AIN0~AIN35	AIN0~AIN35 ADC input channel 0~35
	ADC_VREF	ADC external reference voltage
VC	VCIN0~VCIN15	VC input 0~15
	VC0_OUT	VC0 comparison output
	VC1_OUT	VC1 comparison output
	VC2_OUT	VC2 comparison output
LVD	LVDIN0	Voltage detection input 0
	LVDIN1	Voltage detection input 1
	LVDIN2	Voltage detection input 2
	LVD_OUT	Voltage detection output
OPA $x=0,1,2,3,4$	OPx_INN	OPA negative input
	OPx_INP	OPA positive input
	OPx_OUTy	OPA output
LCD $x=0\sim 7$ $y=0\sim 52$ $z=1,2,3,H$	COMx	LCD common output
	SEGy VLCDz	LCD segment output External resistor mode, external capacitor mode use pins
UART $x=0,1,2,3$	UARTx_TXD	UARTx data transmitter
	UARTx_RXD	UARTx data receiver
	UARTx_CTS	UARTx CTS
	UARTx_RTS	UARTx RTS
LPUART $x=0,1$	LPUARTx_TXD	LPUART data transmitter
	LPUARTx_RXD	LPUART data receiver
	LPUARTx_CTS	LPUART CTS
	LPUARTx_RTS	LPUART RTS

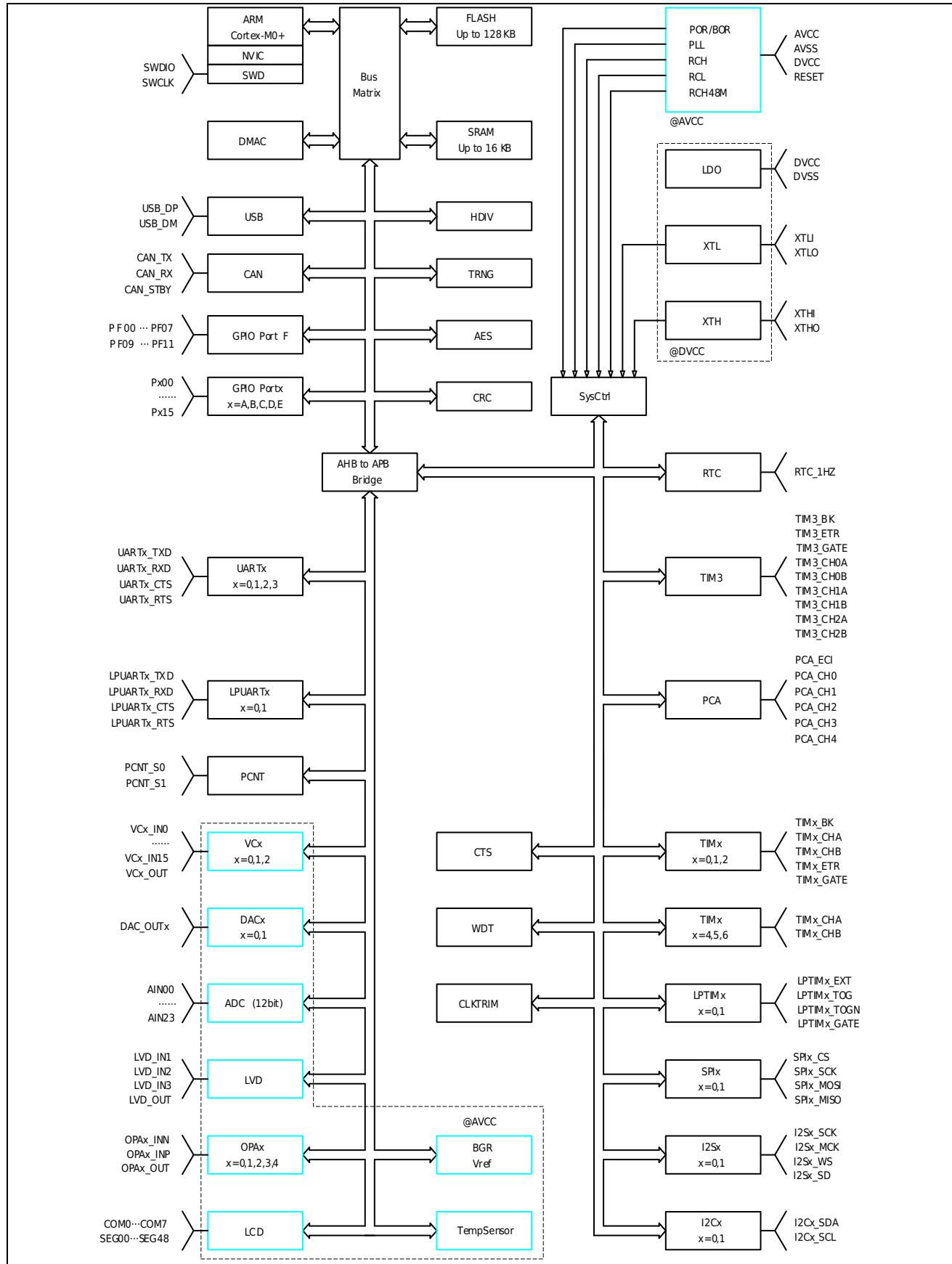
Module	Pin Name	Description
I2Sx x=0,1	I2Sx_CK	I2Sx_CK I2S module clock signal
	I2Sx_WS	I2Sx_WS I2S module word select signal
	I2Sx_MCK	I2Sx_MCK I2S module master mode clock output
	I2Sx_SD	I2Sx_SD I2S module data input and output
USB	USB_DP	USB data signal
	USB_DM	USB data signal
CAN	CAN_TX	CAN TX output signal
	CAN_RX	CAN RX input signal
	CAN_STBY	CAN STBY signal
CTS	CTS_SYNC	CTS external synchronization signal
SPI x=0,1	SPIx_MISO	SPI module master input slave output data signal
	SPIx_MOSI	SPI module master output slave input data signal
	SPIx_SCK	SPI module clock signal
	SPIx_CS	SPI chip select
I2C x=0,1	I2Cx_SDA	I2C module data signal
	I2Cx_SCL	I2C module clock signal
General purpose timer TIMx x=0,1,2	TIMx_CHA	Timer capture input compare output A
	TIMx_CHB	Timer capture input compare output B
	TIMx_ETR	Timer external count input signal
	TIMx_GATE	Timer gate signal
General purpose timer TIM3 y=0,1,2	TIM3_CHyA	Timer capture input compare output A
	TIM3_CHyB	Timer capture input compare output B
	TIM3_ETR	Timer external count input signal
	TIM3_GATE	Timer gate signal
Low Power Timer LPTIMx x=0,1	LPTIMx_TOG	The toggle output signal of LPTimer
	LPTIMx_TOGN	The toggle output inverse signal of LPTimer
	LPTIMx_EXT	The external count input signal of LPTimer
	LPTIMx_GATE	The gate signal of LPTimer
Programmable Counter Array (PCA)	PCA_ECI	External clock input signal
	PCA_CH0	Capture input/compare output/PWM output 0
	PCA_CH1	Capture input/compare output/PWM output 1
	PCA_CH2	Capture input/compare output/PWM output 2
	PCA_CH3	Capture input/compare output/PWM output 3
	PCA_CH4	Capture input/compare output/PWM output 4
PCNT	PCNT_S0	PCNT Pulse count input 0
	PCNT_S1	PCNT Pulse count input 1
Advanced Timer	TIM4_CHA	Advanced Timer4 compare output/capture input A
	TIM4_CHB	Advanced Timer4 compare output/capture input B

Module	Pin Name	Description
	TIM5_CHA	Advanced Timer5 Compare Output/Capture Input A
	TIM5_CHB	Advanced Timer5 Compare Output/Capture Input B
	TIM6_CHA	Advanced Timer6 Compare Output/Capture Input A
	TIM6_CHB	Advanced Timer6 Compare Output/Capture Input B

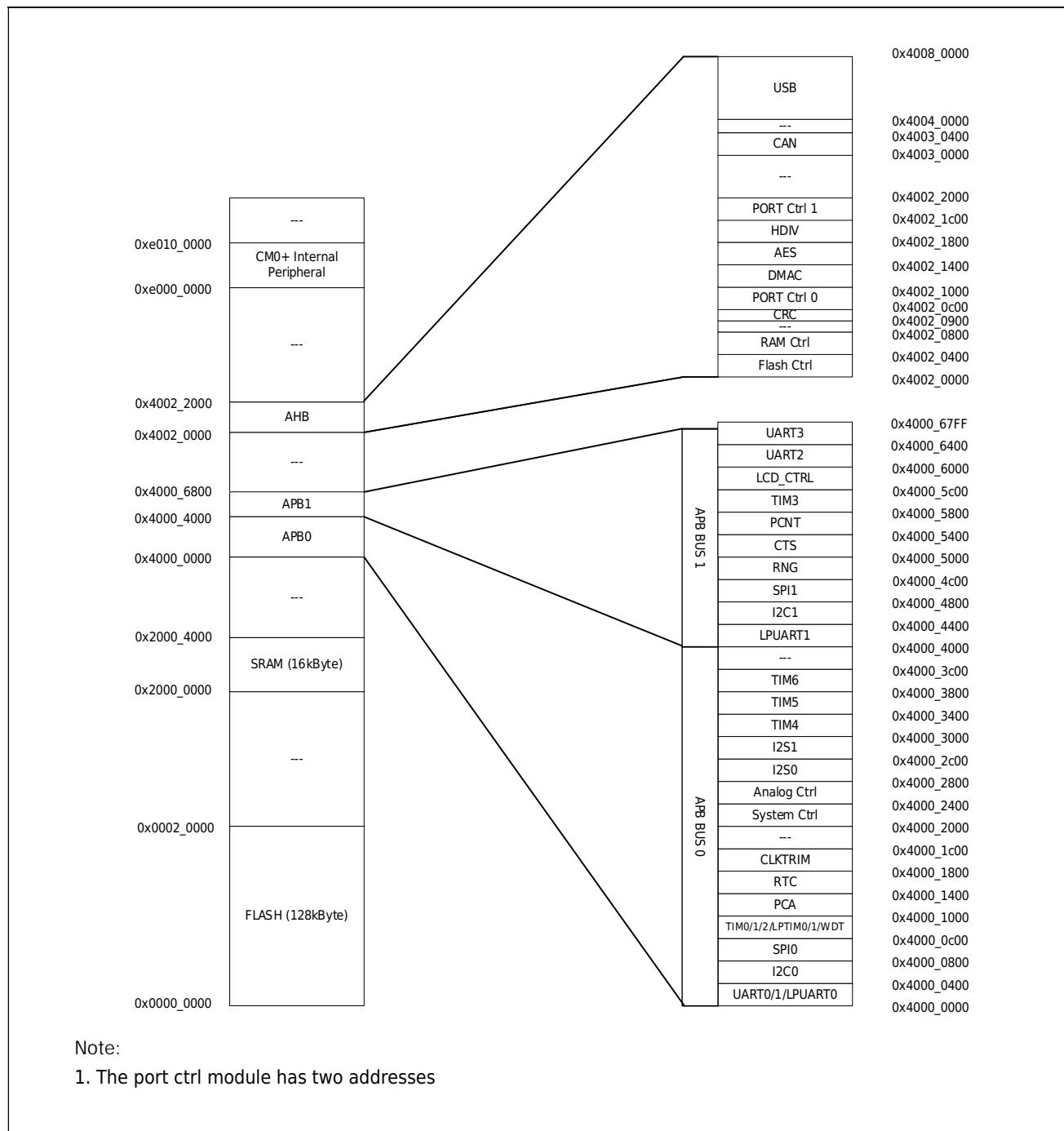
Note:

- The IO ports are reset to input high-impedance state, and the sleep mode and deep sleep mode retain the previous port status.

## 4 Functional Block Diagram

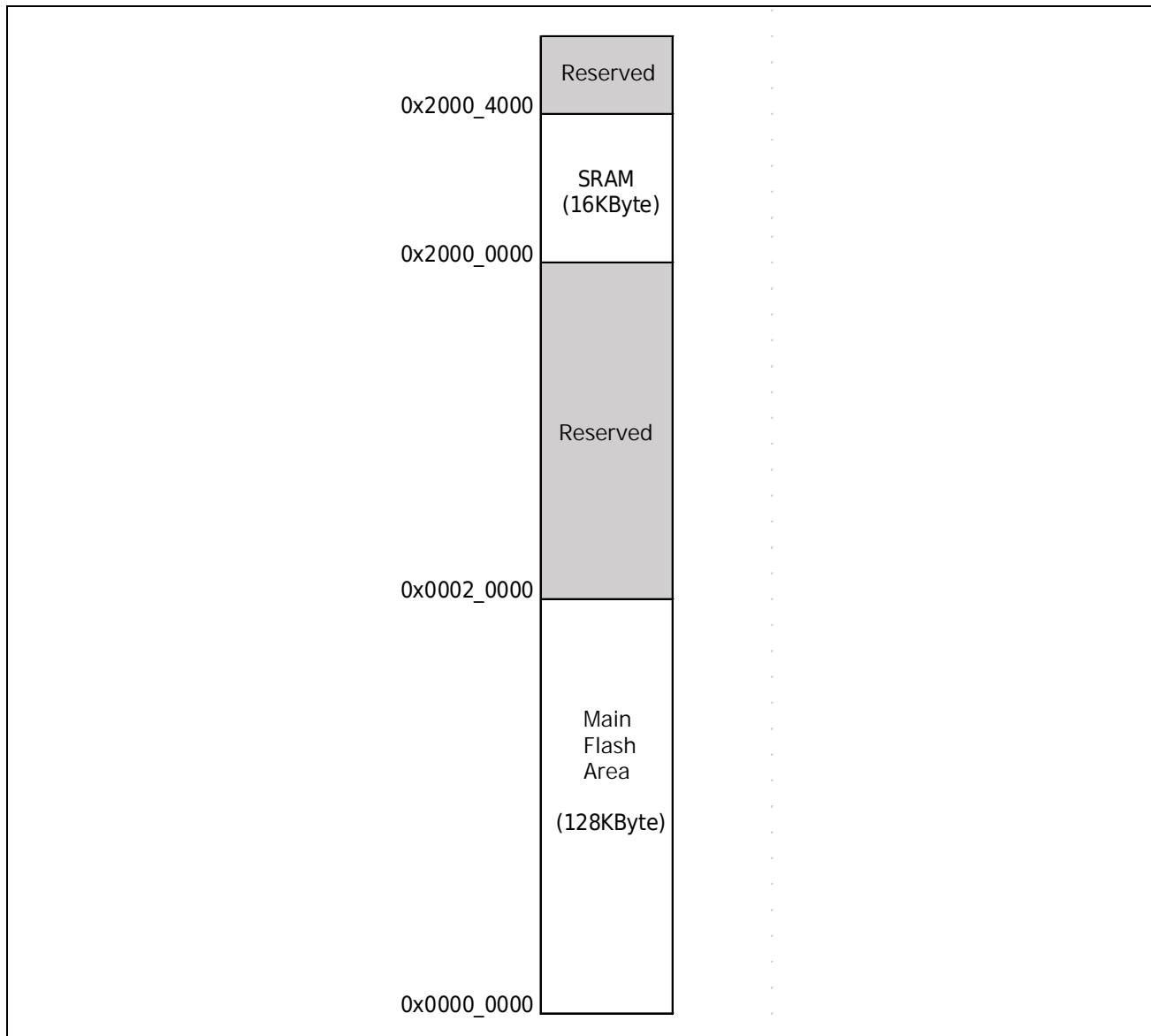


## 5 Memory Map

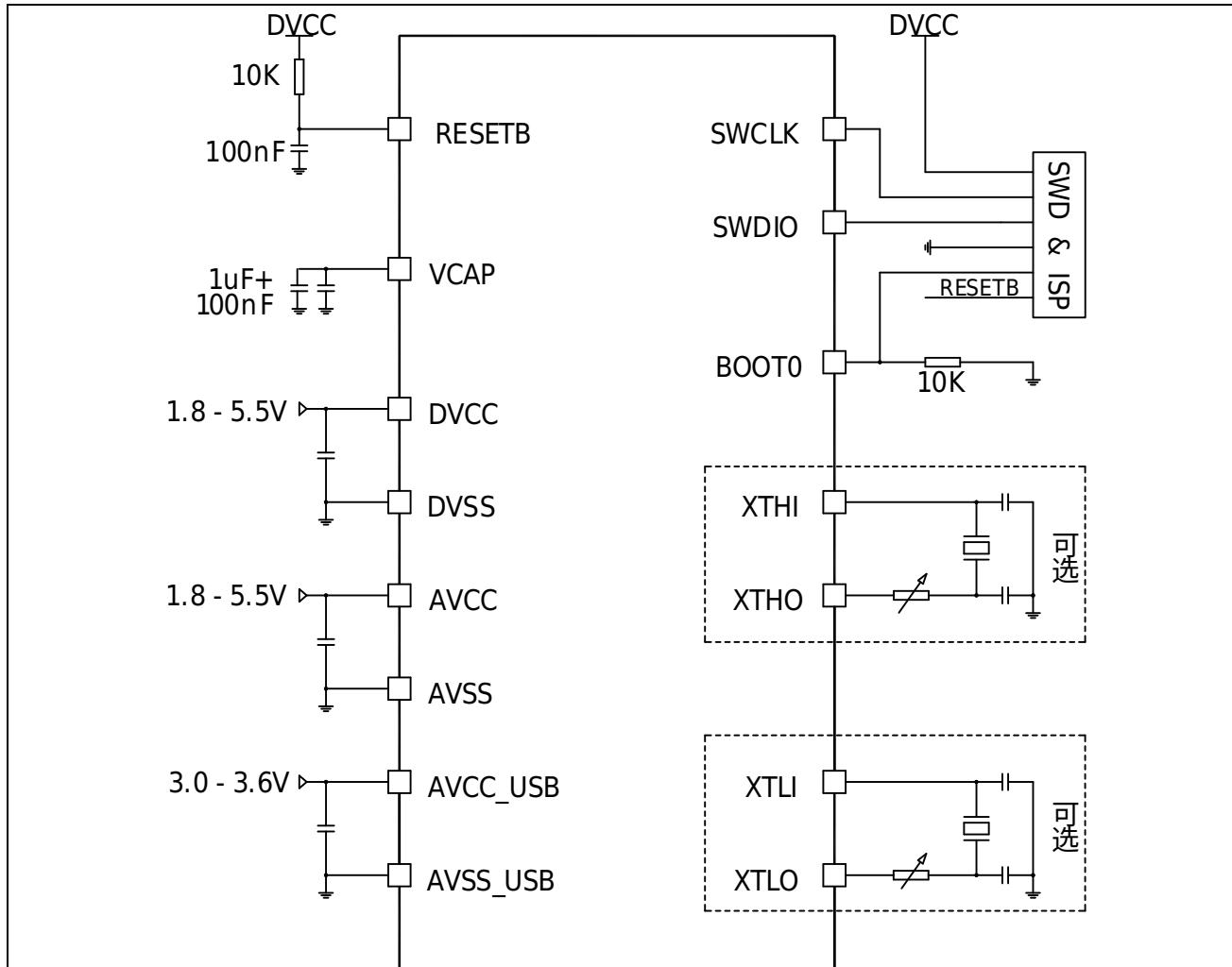


Note:

1. The port ctrl module has two addresses



## 6 Typical application circuit diagram



Notes:

- AVCC and DVCC voltages must be the same.
- When powering AVCC\_USB, the voltages of AVCC and DVCC should not be less than AVCC\_USB.
- When the USB function is not used, it is recommended that the AVCC\_USB pin be left floating or grounded.
- Each power supply requires a decoupling capacitor, which should be placed as close to the corresponding power pin as possible.

## 7 Electrical characteristics

### 7.1 Test conditions

Unless otherwise specified, all voltages are referenced to VSS.

#### 7.1.1 Minimum and maximum values

Unless otherwise specified, all minimum and maximum values are guaranteed under the worst-case ambient temperature, supply voltage and clock frequency conditions by testing 100% of the products at ambient temperature  $T_A=25^\circ\text{C}$  and  $T_A=T_{\text{Amax}}$  ( $T_{\text{Amax}}$  matches the selected temperature range) on the production line.

The notes below each table indicate that the data are obtained through comprehensive evaluation, design simulation and/or process characteristics, and are not tested on the production line; based on comprehensive evaluation, the minimum and maximum values are obtained by taking the average value of the sample test and then adding or subtracting three times the standard distribution (average  $\pm 3\Sigma$ ).

#### 7.1.2 Typical values

Unless otherwise specified, typical data is based on  $T_A = 25^\circ\text{C}$  and  $VCC = 3.3\text{V}$  ( $1.8\text{V} \leq VCC \leq 5.5\text{V}$  voltage range). These data are only for design guidance and are not tested.

The typical ADC accuracy value is obtained by sampling a standard batch and testing it under all temperature ranges. The error of 95% of the products is less than or equal to the given value (average  $\pm 2\Sigma$ ).

## 7.2 Absolute Maximum Ratings

If the load applied to the device exceeds the value given in the "Absolute Maximum Ratings" table, it may cause permanent damage to the device. This is just the maximum load that can be tolerated, and it does not mean that the functional operation of the device is correct under this condition. The long-term operation of the device under the maximum value condition will affect the reliability of the device.

**Table 7-1 Voltage characteristics**

Symbol	Description	Min	Max	Unit
VCC - VSS	External main supply voltage (including AVCC and DVCC) <sup>(1)</sup>	-0.3	5.5	V
AVCC_USB	USB module supply voltage <sup>(2)</sup>	3.0	3.6	V
V <sub>IN</sub>	Input voltage on other pins <sup>(3)</sup>	VSS-0.3	VCC + 0.3	V
ΔVCCx	Voltage difference between different supply pins		50	mV
VSSx - VSS	Voltage difference between different ground pins		50	mV
V <sub>ESD(HBM)</sub>	Electrostatic Discharge Voltage (Human Body Model)	Refer to Absolute Maximum Electrical Parameters		V

1. All power (DVCC, AVCC) and ground (DVSS, AVSS) pins must always be connected to the power supply system within the external allowable range.
2. AVCC\_USB cannot be higher than AVCC/DVCC 0.3V.
3. I<sub>INJ(PIN)</sub> must never exceed its limit, that is, ensure that V<sub>IN</sub> does not exceed its maximum value. If it is not possible to ensure that V<sub>IN</sub> does not exceed its maximum value, it is also necessary to ensure that I<sub>INJ(PIN)</sub> does not exceed its maximum value under external limits. When V<sub>IN</sub>>V<sub>C</sub>, there is a forward injection current; when V<sub>IN</sub><V<sub>S</sub>, there is a reverse injection current.

**Table 7-2 Current characteristics**

Symbol	Description	Max <sup>(1)</sup>	Unit
I <sub>VCC</sub>	Total current through DVCC/AVCC power supply line (supply current) <sup>(1)</sup>	300	mA
I <sub>VSS</sub>	I <sub>VSS</sub> Total current through VSS ground line (source current) <sup>(1)</sup>	300	mA
I <sub>IO</sub>	Output current sinking on any I/O and control pins	25	mA
	Output current sourcing on any I/O and control pins	-25	mA
I <sub>INJ(PIN)</sub> <sup>(2) (3)</sup>	Injection current at RESETB pin	+/-5	mA
	Injection current at XTH1 pin of XTH and XTL1 pin of XTL	+/-5	mA
	Injection current at other pins <sup>(4)</sup>	+/-5	mA
ΣI <sub>INJ(PIN)</sub> <sup>(2)</sup>	Total injection current at all I/O and control pins <sup>(4)</sup>	+/-25	mA

1. All power supply (DVCC, AVCC) and ground (DVSS, AVSS) pins must always be connected to the power supply system within the external allowable range.
2. I<sub>INJ(PIN)</sub> must never exceed its limit, that is, ensure that V<sub>IN</sub> does not exceed its maximum value. If it is not possible to ensure that V<sub>IN</sub> does not exceed its maximum value, it is also necessary to ensure that I<sub>INJ(PIN)</sub> does not exceed its maximum value externally. When V<sub>IN</sub>>V<sub>C</sub>, there is a forward injection current; when V<sub>IN</sub><V<sub>S</sub>, there is a reverse injection current.
3. Reverse injection current will interfere with the analog performance of the device.
4. When several I/O ports have injection current at the same time, the maximum value of ΣI<sub>INJ(PIN)</sub> is the sum of the instantaneous absolute values of the forward injection current and the reverse injection current. This result is based on the characteristics of the maximum value of ΣI<sub>INJ(PIN)</sub> on the 4 I/O ports of the device.

**Table 7-3 Temperature Characteristics**

Symbol	Description	Value	Unit
T <sub>STG</sub>	Storage temperature range	-65 ~ + 150	°C
T <sub>J</sub>	Maximum junction temperature	105	°C

## 7.3 Operating conditions

### 7.3.1 General operating conditions

**Table 7-4 General operating conditions**

Symbol	Parameter	Conditions	Min.	Max.	Unit
f <sub>HCLK</sub>	Internal AHB clock frequency		0	48	MHz
f <sub>PCLK0</sub>	Internal APB0 clock frequency		0	48	MHz
f <sub>PCLK1</sub>	Internal APB1 clock frequency		0	48	MHz
DVCC	Digital part operating voltage	AVCC_USB=0V	1.8	5.5	V
AVCC <sup>(1)</sup>	Analog part operating voltage		1.8	5.5	V
DVCC	Digital part operating voltage	AVCC_USB>3.0V	AVCC_USB	5.5	V
AVCC <sup>(1)</sup>	Analog part operating voltage		AVCC_USB	5.5	V
AVCC_USB	USB module supply voltage		3.0	3.6	V
P <sub>D</sub>	Power dissipation TA=85°C	LQFP100		476	mW
	Power dissipation TA=85°C	LQFP64		455	mW
	Power dissipation TA=85°C	LQFP48		364	mW
	Power dissipation TA=85°C	QFN32		556	mW
T <sub>A</sub>	Ambient temperature	Maximum power consumption	-40	85	°C
		Low power consumption <sup>(2)</sup>	-40	105	°C
T <sub>J</sub>	Junction temperature range		-40	105	°C

1. AVCC and DVCC voltages must be the same.

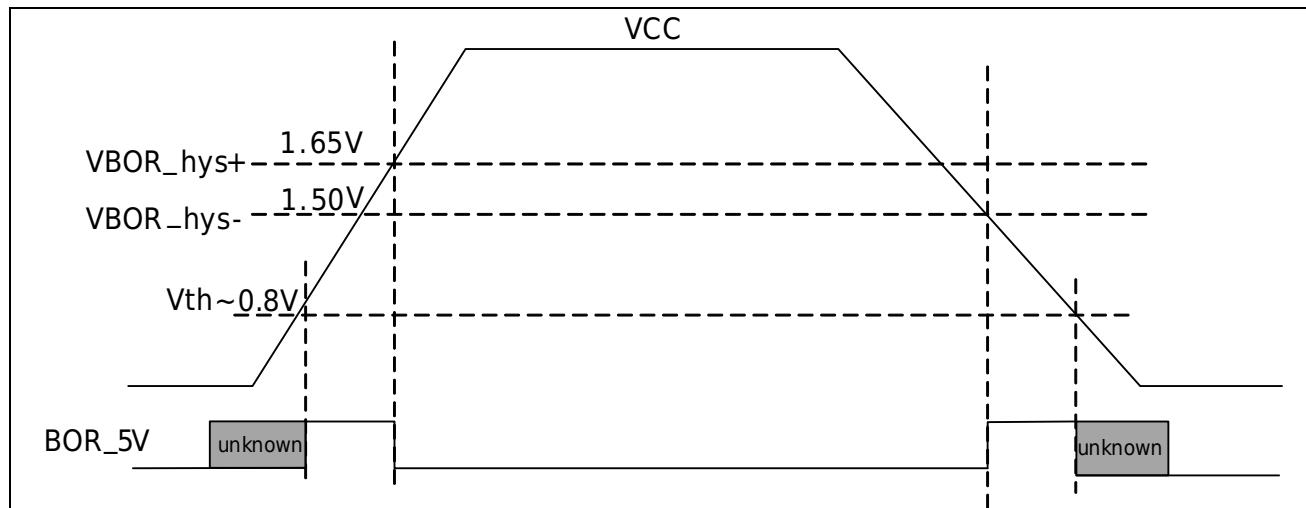
2. In the state of lower power dissipation, TA can be extended to this range as long as T<sub>J</sub> does not exceed T<sub>Jmax</sub>.

### 7.3.2 Operating conditions during power-on and power-off

**Table 7-5 Power-on and power-off operating conditions**

Symbol	Parameter	Conditions	Min.	Max.	Unit
t <sub>VCC</sub>	VCC rising rate		0	5	V/μs
t <sub>VCC</sub>	VCC falling rate		10	5	V/μs

### 7.3.3 Embedded reset and LVD module features



1. Guaranteed by design, not tested in production.

**Figure 7-1 POR/Brown Out diagram**

**Table 7-6 POR/Brown Out**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Vpor	POR release voltage (power-on process) BOR detection voltage (power-off process)		1.45	1.50	1.65	V

**Table 7-7 LVD module characteristics**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Vex	External input voltage range		0		VCC	V
Vlevel	Detection Threshold	LVD_CR.VTDS=0000	1.7	1.8	1.9	
		LVD_CR.VTDS =0001	1.8	1.9	2.0	
		LVD_CR.VTDS =0010	1.9	2.0	2.1	
		LVD_CR.VTDS =0011	2.0	2.1	2.2	
		LVD_CR.VTDS =0100	2.1	2.2	2.3	
		LVD_CR.VTDS=0101	2.2	2.3	2.4	
		LVD_CR.VTDS=0110	2.3	2.4	2.5	
		LVD_CR.VTDS=0111	2.4	2.5	2.6	
		LVD_CR.VTDS=1000	2.5	2.6	2.7	
		LVD_CR.VTDS=1001	2.6	2.7	2.8	
		LVD_CR.VTDS=1010	2.7	2.8	2.9	
		LVD_CR.VTDS=1011	2.8	2.9	3.0	
		LVD_CR.VTDS=1100	2.9	3.0	3.1	
		LVD_CR.VTDS=1101	3.0	3.1	3.2	
		LVD_CR.VTDS=1110	3.1	3.2	3.3	
		LVD_CR.VTDS=1111	3.2	3.3	3.4	
Icomp	Power consumption			0.12		µA
Tresponse	Response time			80		µs
Tsetup	Settling Time			400		µs
Vhyste	Hysteresis voltage			40		mV
Tfilter	Filter time	LVD_debounce = 000		7		
		LVD_debounce = 001		14		
		LVD_debounce = 010		28		
		LVD_debounce = 011		112		
		LVD_debounce = 100		450		
		LVD_debounce = 101		1800		
		LVD_debounce = 110		7200		
		LVD_debounce = 111		28800		

### 7.3.4 Built-in reference voltage

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V <sub>REF25</sub>	Internal 2.5V Reference Voltage	Normal temperature 25°C 3.3V	2.475	2.5	2.525	V
V <sub>REF25</sub>	Internal 2.5V Reference Voltage	-40 ~ 85°C 2.8 ~ 5.5V	2.463	2.5	2.525	V <sup>[1]</sup>
V <sub>REF15</sub>	Internal 1.5V Reference Voltage	Normal temperature 25°C 3.3V	1.485	1.5	1.515	V
V <sub>REF15</sub>	Internal 1.5V Reference Voltage	-40 ~ 85°C 1.8 ~ 5.5V	1.477	1.5	1.519	V <sup>[1]</sup>
T <sub>Coeff</sub>	Internal 2.5V 1.5V temperature coefficient	-40 ~ 85°C			120	ppm/°C

1. The data is based on characterization results and is not tested in production.

### 7.3.5 Supply current characteristics

Current consumption is a composite indicator of many parameters and factors, including operating voltage, ambient temperature, I/O pin load, product software configuration, operating frequency, I/O pin flip rate, program location in memory, and executed code.

The microcontroller is in the following conditions:

- All I/O pins are in input mode and connected to a static level - VCC or VSS (no load).
- All peripherals are turned off unless otherwise specified.
- The access time of the flash memory is adjusted to the frequency of fHCLK (0 wait cycles for 0~24MHz, 1 wait cycle for 24~48MHz).
- When the peripherals are turned on: fPCLK0 = fHCLK, fPCLK1 = fHCLK.

**Table 7-8 Operating current characteristics**

Symbol	Parameter	Conditions			Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Unit
IDD (AVCC_USB)		Active			4		mA
IDD (Run in RAM)	All peripherals clock ON, Run while(1) in RAM	Vcap=1.5V Vcc=3.3V TA=2xC	RCH clock source	4M	990		µA
				8M	1960		
				16M	3870		
				22.12M	5360		
				24M	5780		
			PLL RCH4M to xxM clock source	32M	7910		
				48M	11770		
	All peripherals clock OFF, Run while(1) in RAM	Vcap=1.5V Vcc=3.3V TA=2xC	RCH clock source	4M	340		µA
				8M	650		
				16M	1240		
				22.12M	1700		
				24M	1840		
			PLL RCH4M to xxM clock source	32M	2690		
				48M	3950		
				4M	820		µA

Symbol	Parameter	Conditions			Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Unit		
$I_{DD}$ (Run CoreMark)	All peripherals clock OFF, Run CoreMark in Flash	Vcap=1.5V V <sub>CC</sub> =3.3V T <sub>A</sub> =2xC	RCH clock source	8M	1550		$\mu A$		
				16M	2980				
				22.12M	4000				
				24M	4320				
			PLL RCH4M to xxM	48M FlashWait=1	6810				
	All peripherals clock ON, Run while(1) in Flash	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V T <sub>A</sub> =N40-85°C	RCH clock source	4M	1330	1800	$\mu A$		
				8M	2490	3430			
				16M	4990	6570			
				22.12M	6760	8960			
		Vcap=1.5V V <sub>CC</sub> =1.8-5.5V T <sub>A</sub> =N40C- 85°C	PLL RCH4M to xxM clock source	24M	7260	9680			
$I_{DD}$ (Run mode)	All peripherals clock OFF, Run while(1) in Flash			16M	5270	6550	$\mu A$		
				24M	7390	9260			
				32M FlashWait=1	9200	10640			
				40M FlashWait=1	11350	13150			
				48M FlashWait=1	13470	15750			
	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V T <sub>A</sub> =N40-85°C	PLL RCH8M to xxM clock source	16M	5350	6620	$\mu A$			
			24M	7460	9390				
			32M FlashWait=1	9250	10740				
			40M FlashWait=1	11380	13290				
			48M FlashWait=1	13560	15850				
	All peripherals clock ON, Run while(1) in Flash	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V T <sub>A</sub> =N40-85°C	RCH clock source	4M	670	1080	$\mu A$		
				8M	1190	1990			
				16M	2280	3580			
				22.12M	3070	4790			
				24M	3290	5120			
		Vcap=1.5V V <sub>CC</sub> =1.8-5.5V T <sub>A</sub> =N40-85°C	PLL RCH4M to xxM clock source	16M	2560	3530	$\mu A$		
				24M	3450	4780			
				32M FlashWait=1	3950	4670			
				40M FlashWait=1	4800	5710			
				48M FlashWait=1	5680	6780			
				16M	2620	3610			

Symbol	Parameter	Conditions			Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Unit
$I_{DD}$ (Sleep mode)	All peripherals clock ON	Vcap=1.5V Vcc=1.8-5.5V TA=N40-85°C	RCH clock source	4M	840	950	$\mu A$
				8M	1640	1880	
				16M	3240	3680	
				22.12M	4490	5120	
				24M	4850	5570	
		Vcap=1.5V Vcc=1.8-5.5V TA=N40-85°C	PLL RCH4M to xxM clock source	16M	3550	4070	$\mu A$
				24M	5060	5770	
				32M FlashWait=1	6680	7640	
				40M FlashWait=1	8300	9510	
				48M FlashWait=1	9920	11370	
		Vcap=1.5V Vcc=1.8-5.5V TA=N40-85°C	PLL RCH8M to xxM clock source	16M	3620	4120	$\mu A$
				24M	5120	5850	
				32M FlashWait=1	6740	7710	
				40M FlashWait=1	8340	9580	
				48M FlashWait=1	9980	11430	
	All peripherals clock OFF	Vcap=1.5V Vcc=1.8-5.5V TA=N40-85°C	RCH clock source	4M	180	230	$\mu A$
				8M	330	390	
				16M	600	690	
				22.12M	820	930	
				24M	880	1000	
		Vcap=1.5V Vcc=1.8-5.5V TA=N40-85°C	PLL RCH4M to xxM clock source	16M	900	1020	$\mu A$
				24M	1110	1260	
				32M FlashWait=1	1410	1610	
				40M FlashWait=1	1730	1970	
				48M FlashWait=1	2040	2330	
	All peripherals clock ON, Run while(1) in Flash	Vcap=1.5V Vcc=1.8-5.5V	XTL32K clock source Driver=0x0	16M	960	1090	$\mu A$
				24M	1170	1330	
				32M FlashWait=1	1470	1670	
				40M FlashWait=1	1780	2030	
				48M FlashWait=1	2100	2390	
				TA=N40-25C	14	19	
$I_{DD}$ (LP Run)	All peripherals clock ON, Run while(1) in Flash	Vcap=1.5V Vcc=1.8-5.5V	XTL32K clock source Driver=0x0	TA=50C	15	20	$\mu A$
				TA=85C	21	28	
				TA=N40-25C	9	13	
	All peripherals clock OFF, Run while(1) in Flash	Vcap=1.5V Vcc=1.8-5.5V	XTL32K clock source Driver=0x0	TA=50C	10	14	$\mu A$
				TA=85C	16	22	

Symbol	Parameter	Conditions			Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Unit
$I_{DD}$ (LP Sleep)	All peripherals clock ON	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V	XTL32K clock source Driver=0x0	TA=N40-25C	9	10	$\mu A$
				TA=50C	10	11	
				TA=85C	16	18	
	All peripherals clock OFF	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V	XTL32K clock source Driver=0x0	TA=N40-25C	4	4	$\mu A$
				TA=50C	5	5	
				TA=85C	11	13	
	LpTimer+RTC+32 K clk ON, Other clk OFF	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V	XTL32K clock source Driver=0x0	TA=N40-25C	4	4	$\mu A$
				TA=50C	5	6	
				TA=85C	11	13	
$I_{DD}$ (DeepSleep mode)	RTC+WDT+LPT+ XTL32K +DeepSleep	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V	XTL32K Driver=0x0	TA=N40-25C	1750	2040	nA
				TA=50C	2460	2990	
				TA=85C	6940	8620	
	LPT+XTL32K +DeepSleep	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V	XTL32K Driver=0x0	TA=N40-25C	1630	1910	nA
				TA=50C	2340	2850	
				TA=85C	6810	8510	
	RTC+XTL32K +DeepSleep	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V	XTL32K Driver=0x0	TA=N40-25C	1590	1870	nA
				TA=50C	2300	2810	
				TA=85C	6800	8470	
	XTL32K +DeepSleep	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V	XTL32K Driver=0x0	TA=N40-25C	1580	1860	nA
				TA=50C	2290	2790	
				TA=85C	6750	8410	
	IRC32K +DeepSleep	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V		TA=N40-25C	1570	1830	nA
				TA=50C	2270	2750	
				TA=85C	6750	8410	
	WDT +DeepSleep	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V		TA=N40-25C	1300	1520	nA
				TA=50C	1990	2430	
				TA=85C	6410	8020	
	DeepSleep	Vcap=1.5V V <sub>CC</sub> =1.8-5.5V		TA=N40-25C	1190	1400	nA
				TA=50C	1880	2310	
				TA=85C	6330	7970	

1. If no other conditions are specified, the Typ value is measured at 25°C & VCC = 3.3V.

2. If no other conditions are specified, the Max value is the maximum value in the range of VCC = 1.8-5.5V & Temperature = N40 - 85°C.

3. The data is based on the characterization results and is not tested in production.

### 7.3.6 Wake-up time from low power modes

The wake-up time is measured during the wake-up phase of the RCH oscillator. The clock source used during wake-up depends on the current operating mode:

- Sleep mode: The clock source is the RCH oscillator
- Deep sleep mode: The clock source is the RCH oscillator used when entering deep sleep

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T <sub>wu</sub>	Sleep mode wake-up time			1.8		μs
	Deep sleep wake-up time	F <sub>MCLK</sub> = 4MHz		9.0		μs
		F <sub>MCLK</sub> = 8MHz		6.0		μs
		F <sub>MCLK</sub> = 16MHz		5.0		μs
		F <sub>MCLK</sub> = 24MHz		4.0		μs

1. The wake-up time is measured from the wake-up event to the first instruction read by the user program.

## 7.3.7 External clock source characteristics

### 7.3.7.1 External high-speed clock input

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f <sub>XTH_ext</sub>	User external clock frequency <sup>(1)</sup>		0	8	32	MHz
V <sub>XTHH</sub>	Input pin high level voltage		0.7VCC		VCC	V
V <sub>XTHL</sub>	Input pin low level voltage		VSS		0.3VCC	V
T <sub>r(XTH)</sub>	Rise time <sup>(1)</sup>				20	ns
T <sub>f(XTH)</sub>	Fall time <sup>(1)</sup>				20	ns
T <sub>w(XTH)</sub>	Input high or low time <sup>(1)</sup>		16			ns
C <sub>in(XTH)</sub>	Input capacitance <sup>(1)</sup>			5		pF
Duty	Duty cycle		40		60	%
I <sub>L</sub>	Input leakage current				±1	µA

1. Guaranteed by design, not tested in production.

### 7.3.7.2 External low speed clock input

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f <sub>XTL_ext</sub>	User external clock frequency <sup>(1)</sup>		0	32.768	1000	kHz
V <sub>XTLH</sub>	Input pin high level voltage		0.7VCC		VCC	V
V <sub>XTLL</sub>	Input pin low level voltage		VSS		0.3VCC	V
T <sub>r(XTL)</sub>	Rise time <sup>(1)</sup>				50	ns
T <sub>f(XTL)</sub>	Fall time <sup>(1)</sup>				50	ns
T <sub>w(XTL)</sub>	Input high or low time <sup>(1)</sup>		450			ns
C <sub>in(XTL)</sub>	Input capacitance <sup>(1)</sup>			5		pF
Duty	Duty cycle		30		70	%
I <sub>L</sub>	Input leakage current				±1	µA

1. Guaranteed by design, not tested in production.

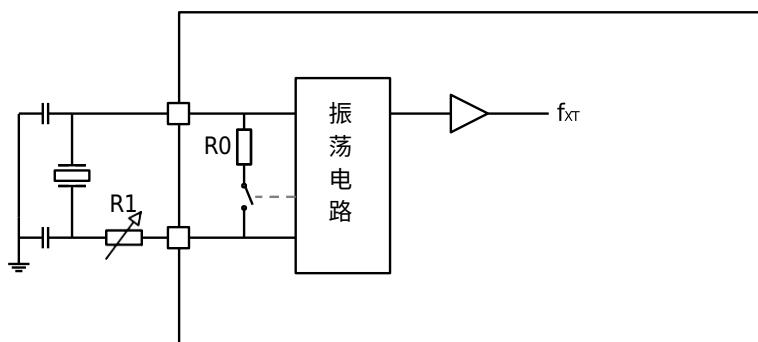
### 7.3.7.3 High-speed external clock XTH

The high-speed external clock (XTH) can be generated using an 8~32MHz crystal/ceramic resonator oscillator. The information given in this section is based on the results obtained through comprehensive characteristic evaluation using the typical external components listed in the table below. In the application, the resonator and load capacitors must be as close to the oscillator pins as possible to reduce output distortion and stabilization time at startup. For detailed parameters of the crystal resonator (frequency, package, accuracy, etc.), please consult the corresponding manufacturer.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$F_{CLK}$	Frequency	-	8	-	32	MHz
$ESR_{CLK}$	ESR range	32MHz	-	-	60	$\Omega$
		24MHz	-	-	80	
		16MHz	-	-	100	
		8MHz	-	-	120	
$C_{LX}^{(3)}$	Load Capacitance	Configured as required by the crystal manufacturer.	4	12	20	pF
Duty	Duty Cycle	-	40	50	60	%
$I_{dd}^{(4)}$	Current	XTH_CR[3:0]=0b1111	-	1000	-	$\mu A$
		XTH_CR[3:0]=0b1110	-	600	-	
		XTH_CR[3:0]=0b1010	-	370	-	
		XTH_CR[3:0]=0b0110	-	300	-	
		XTH_CR[3:0]=0b0010	-	160	-	
$g_m$	Transconductance	XTH_CR[3:0]=0b1111	-	11.75	-	$mA/V$
		XTH_CR[3:0]=0b1110 (32MHz, 24MHz Recommended value)	-	6.34	-	
		XTH_CR[3:0]=0b1101	-	4.38	-	
		XTH_CR[3:0]=0b1100	-	3.38	-	
		XTH_CR[3:0]=0b1011	-	7.41	-	
		XTH_CR[3:0]=0b1010 (16MHz Recommended value)	-	4.01	-	
		XTH_CR[3:0]=0b1001	-	2.77	-	
		XTH_CR[3:0]=0b1000	-	2.14	-	
		XTH_CR[3:0]=0b0111	-	5.59	-	
		XTH_CR[3:0]=0b0110 (12MHz Recommended value)	-	3.01	-	
		XTH_CR[3:0]=0b0101	-	2.08	-	
		XTH_CR[3:0]=0b0100	-	1.60	-	
		XTH_CR[3:0]=0b0011	-	2.50	-	
		XTH_CR[3:0]=0b0010 (8MHz Recommended value)	-	1.30	-	

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		XTH_CR[3:0]=0b0001	-	0.93	-	
		XTH_CR[3:0]=0b0000	-	0.72	-	
T <sub>start</sub> <sup>(5)</sup>	Startup time	32MHz, CL=16pF @ XTH_CR[3:0]=0b1110	-	500	-	μs
		8MHz, CL=16pF @ XTH_CR[3:0]=0b0010	-	2	-	ms

1. The characteristic parameters of the resonator are given by the crystal/ceramic resonator manufacturer.
  2. Derived from comprehensive evaluation, not tested in production.
  3. CLx refers to the load capacitance CL1 and CL2 of the two pins of XTAL. For CL1 and CL2, it is recommended to use high-quality ceramic capacitors designed for high-frequency applications and select a crystal or resonator that meets the requirements. Usually CL1 and CL2 have the same parameters. Crystal manufacturers usually give the parameters of the load capacitance as a series combination of CL1 and CL2. When selecting CL1 and CL2, the parameters such as the frequency and ESR of the crystal should be considered, and the capacitance of the PCB and MCU pins should be taken into account.
  4. The current varies with the selection of frequency and drive capability. The higher the frequency and the stronger the drive capability, the greater the current consumption.
- T<sub>start</sub> is the start-up time, which is measured from the software enabling XTH until a stable 32MHz/8MHz oscillation is obtained. This value is measured with a standard crystal resonator at XTH\_CR[5:4] = 0b10 and may vary greatly depending on the crystal manufacturer and model.



Note:

- It is recommended to configure the crystal matching capacitor according to the requirements of the crystal manufacturer's technical manual. If the crystal manufacturer specifies the load capacitance, the matching capacitor should be twice the load capacitance specified by the crystal manufacturer. If the crystal manufacturer specifies the matching capacitor, the matching capacitor specified by the crystal manufacturer can be used directly.
- The chip has integrated feedback resistor R0.
- The damping resistor R1 is optional. The resistance value depends on the crystal characteristics and is 0Ω by default.

### 7.3.7.4 Low-speed external clock XTL

The low-speed external clock (XTL) can be generated using an oscillator composed of a 32.768kHz crystal/ceramic resonator. The information given in this section is based on typical external components and the results obtained through comprehensive characteristic evaluation. In the application, the resonator and load capacitors must be as close to the oscillator pins as possible to reduce output distortion and stabilization time at startup. For detailed parameters of the crystal resonator (frequency, package, accuracy, etc.), please consult the corresponding manufacturer.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$F_{CLK}$	Frequency	-	-	32.768	-	kHz
$ESR_{CLK}$	ESR range	-	-	-	60	kΩ
$C_{Lx}^{(2)}$	Load Capacitance	Configured as required by the crystal manufacturer.	8	12	20	pF
$DC_{ACLK}$	Duty Cycle	-	30	50	70	%
$I_{dd}^{(3)}$	Current	XTL_CR[3:0]=0b1111	-	1330	-	nA
		XTL_CR[3:0]=0b1011	-	1230	-	
		XTL_CR[3:0]=0b0111	-	1140	-	
		XTL_CR[3:0]=0b0011	-	1050	-	
		XTL_CR[3:0]=0b1110	-	630	-	
		XTL_CR[3:0]=0b1010 (推荐值)	-	580	-	
		XTL_CR[3:0]=0b0110	-	530	-	
		XTL_CR[3:0]=0b0010	-	490	-	
$g_m$	Transconductance	XTL_CR[3:0]=0b1111	-	14.64	-	μA/V
		XTL_CR[3:0]=0b1011	-	13.17	-	
		XTL_CR[3:0]=0b0111	-	11.67	-	
		XTL_CR[3:0]=0b0011	-	10.15	-	
		XTL_CR[3:0]=0b1110	-	7.37	-	
		XTL_CR[3:0]=0b1010 (推荐值)	-	6.62	-	
		XTL_CR[3:0]=0b0110	-	5.87	-	
		XTL_CR[3:0]=0b0010	-	5.10	-	
$T_{start}^{(4)}$	Startup time	ESR=30kΩ $C_L=12pF$ XTL_CR[3:0]=0b1010	-	2000	-	ms

1. Derived from comprehensive evaluation, not tested in production.

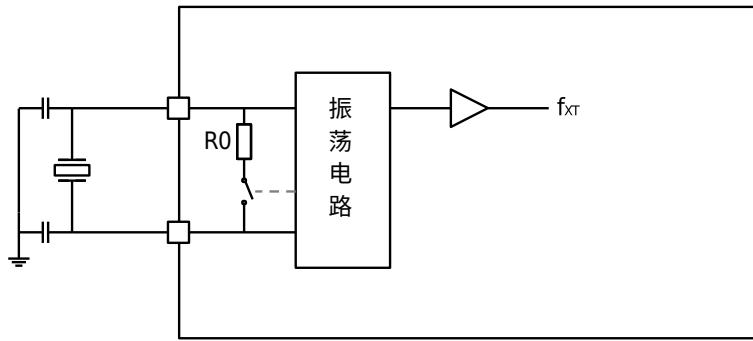
2. CLX refers to the load capacitance of the two pins of XTAL. The user must select the capacitance of the capacitor according to the requirements of the crystal manufacturer.

If the crystal manufacturer gives the capacitance of the load capacitance, the capacitance of the matching capacitor should be twice the capacitance of the load capacitance given by the crystal manufacturer. If the crystal manufacturer gives the capacitance of the matching capacitor, the capacitance of the matching capacitor given by the crystal manufacturer can be used directly.

Example: When the crystal manufacturer gives the crystal load capacitance of 8pF, the capacitance of the matching capacitor should be 16pF. Considering the distributed capacitance between the PCB and the MCU pin, it is recommended to select a matching capacitor with a capacitance of 15pF or 12pF.

When the crystal manufacturer specifies a matching capacitor of 12pF for the crystal, the matching capacitor should be 12pF. Considering the distributed capacitance between the PCB and the MCU pin, it is recommended to select a matching capacitor with a capacitance of 10pF or 8pF.

3. Select a high-quality oscillator with a small ESR value (such as MSIV-TIN32.768kHz). You can optimize the current consumption by adjusting the XTL\_CR[3:0] setting value. The current consumption is proportional to the transconductance ( $gm$ ) provided by the circuit.
4. Tstart is the start-up time, which is measured from the software enabling XTL until a stable 32768 oscillation is obtained. This value is measured on a standard crystal resonator with the settings of XTL\_CR[3:0]=0b1010 and XTL\_CR[5:4]=0b11, and it may vary greatly depending on the crystal manufacturer and model.



#### Notes:

- It is recommended to configure the crystal matching capacitor according to the requirements of the crystal manufacturer's technical manual.  
If the crystal manufacturer specifies the load capacitance value, the matching capacitor value should be twice the load capacitance value specified by the crystal manufacturer.  
If the crystal manufacturer specifies the matching capacitor value, the matching capacitor value specified by the crystal manufacturer can be used directly.
- The feedback resistor R0 is integrated in the chip.

### 7.3.8 Internal clock source characteristics

#### 7.3.8.1 Internal RCH Oscillator

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dev	RCH Oscillator Accuracy	User trimming step for given VCC and TA conditions		0.25		%
		VCC = 1.8 ~ 5.5V T <sub>AMB</sub> = -40 ~ 85°C	-3.5		+3.5	%
		VCC = 1.8 ~ 5.5V T <sub>AMB</sub> = -20 ~ 85°C	-2.5		+2.5	%
		VCC = 1.8 ~ 5.5V T <sub>AMB</sub> = -20 ~ 50°C	-2.0		+2.0	%
F <sub>CLK</sub>	Frequency		4.0	4.0 8.0 16.0 22.12 24.0	24.0	MHz
I <sub>CLK</sub>	Power consumption	F <sub>MCLK</sub> = 4MHz		80		µA
		F <sub>MCLK</sub> = 8MHz		100		µA
		F <sub>MCLK</sub> = 16MHz		120		µA
		F <sub>MCLK</sub> = 24MHz		140		µA
DC <sub>CLK</sub>	Duty Cycle <sup>(1)</sup>		45	50	55	%

1. Derived from comprehensive evaluation, not tested in production.

#### 7.3.8.2 Internal RCL Oscillator

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dev	RCL Oscillator Accuracy	User trimming step for given VCC and TA conditions		0.5		%
		VCC = 1.8 ~ 5.5V T <sub>AMB</sub> = -40 ~ 85°C T <sub>AMB</sub> = -40°C ~ 85°C	-5		+5	%
		VCC = 1.8 ~ 5.5V T <sub>AMB</sub> = -20 ~ 50°C	-3		+3	%
F <sub>CLK</sub>	Frequency			38.4 32.768		kHz
T <sub>CLK</sub>	Startup time			150		µs
DC <sub>CLK</sub>	Duty Cycle <sup>(1)</sup>		25	50	75	%
I <sub>CLK</sub>	Power consumption			0.35		µA

1. Derived from comprehensive evaluation, not tested in production.

#### 7.3.8.3 Internal low speed clock 10k oscillator

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V	Operation voltage	-	1.8		5.5	V
Dev	Oscillator Accuracy <sup>(1)</sup>	VCC = 1.8 ~ 5.5V T <sub>AMB</sub> = -20 ~ 50°C	-50	-	50	%
F <sub>CLK</sub>	Frequency	VCC=3.3v T <sub>AMB</sub> = 25°C		10		KHz

1. Derived from comprehensive evaluation, not tested in production.

#### 7.3.8.4 Internal USB-specific RCH48M oscillator

Parameter	Description	Min	Typ	Max	Units	Condition
DVCC	Analog 5V Supply	1.8	3.3	5.5	V	
T	Junction Temperature	-40	27	105	deg C	
F <sub>RCH48M</sub>	Frequency	-	48	-	MHz	-
TRIM	RCH48M user-trimming step	0.06 <sup>(2)</sup>	0.12	0.2 <sup>(2)</sup>	%	-
DUC <sub>RCH48M</sub>	Duty cycle	45 <sup>(2)</sup>	-	55 <sup>(2)</sup>	%	-
ACC <sub>RCH48M</sub>	Accuracy of the RCH48M oscillator(factory calibrated)	6 <sup>(3)</sup>	-	6 <sup>(3)</sup>	%	T <sub>A</sub> =-40 to 105 °C
		TBD <sup>(3)</sup>	-	TBD <sup>(3)</sup>	%	T <sub>A</sub> =-10 to 85 °C
		TBD <sup>(3)</sup>	-	TBD <sup>(3)</sup>	%	T <sub>A</sub> =0 to 70 °C
		2 <sup>(3)</sup>	-	2 <sup>(3)</sup>	%	T <sub>A</sub> =25 °C
t <sub>su</sub> (RCH48M)	RCH48M oscillator startup time	-	-	20 <sup>(2)</sup>	μs	
I <sub>DDA</sub> (RCH48M)	RCH48M oscillator power consumption	-	270	350 <sup>(2)</sup>	μA	

1. AVCC=3.3V, T<sub>A</sub>=-40 to 105 °C unless otherwise specified.
2. Guaranteed by design, not tested in production.
3. Data based on characterization results, not tested in production.

### 7.3.9 PLL Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Fin <sup>(1)</sup>	Input clock		4	4	24	MHz
	Input clock duty cycle		40		60	%
Fout	Output frequency		8	-	48	MHz
Duty <sup>(1)</sup>	Output duty cycle		48%	-	52%	
Tlock <sup>(1)</sup>	Lock time	Input frequency 4MHz	-	100	200	μs

1. Derived from comprehensive evaluation, not tested in production.

### 7.3.10 Memory characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
ECFLASH	Endurance	Regulator voltage=1.5V, T <sub>AMB</sub> = 25°C	20			kcycles
RET <sub>FLASH</sub>	Data retention time	T <sub>AMB</sub> = 85°C, after 20 kcycles	20			Years
T <sub>b</sub> _prog	Programming time (byte)		22		30	μs
T <sub>w</sub> _prog	Programming time (word)		40		52	μs
T <sub>p</sub> _erase	Page Erase Time		4		5	ms
T <sub>m</sub> _erase	Full chip erase time		30		40	ms

### 7.3.11 EFT Characteristics

Chip reset can restore the system to normal operation.

Symbol	Level/Type
EFT to IO (IEC61000-4-4)	Class:4 (A)
EFT to Power (IEC61000-4-4)	Class:4 (A)

#### Software Recommendations

The software process must include controls for program runaway, such as:

- Corrupted program counter
- Unexpected reset
- Corrupted critical data (control registers, etc.)

When performing EFT testing, interference that exceeds application requirements can be applied directly to the chip power supply or IO. When unexpected actions are detected, the software part is strengthened to prevent unrecoverable errors.

### 7.3.12 ESD characteristics

Using specific measurement methods, the chip is stressed to determine its performance in terms of electrical sensitivity.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>ESD<sub>HBM</sub></sub>	ESD @ Human Body Mode			4		kV
V <sub>ESD<sub>CDM</sub></sub>	ESD @ Charge Device Mode			1		kV
V <sub>ESD<sub>MM</sub></sub>	ESD @ machine Mode			200		V
I <sub>latchup</sub>	Latch up current			200		mA

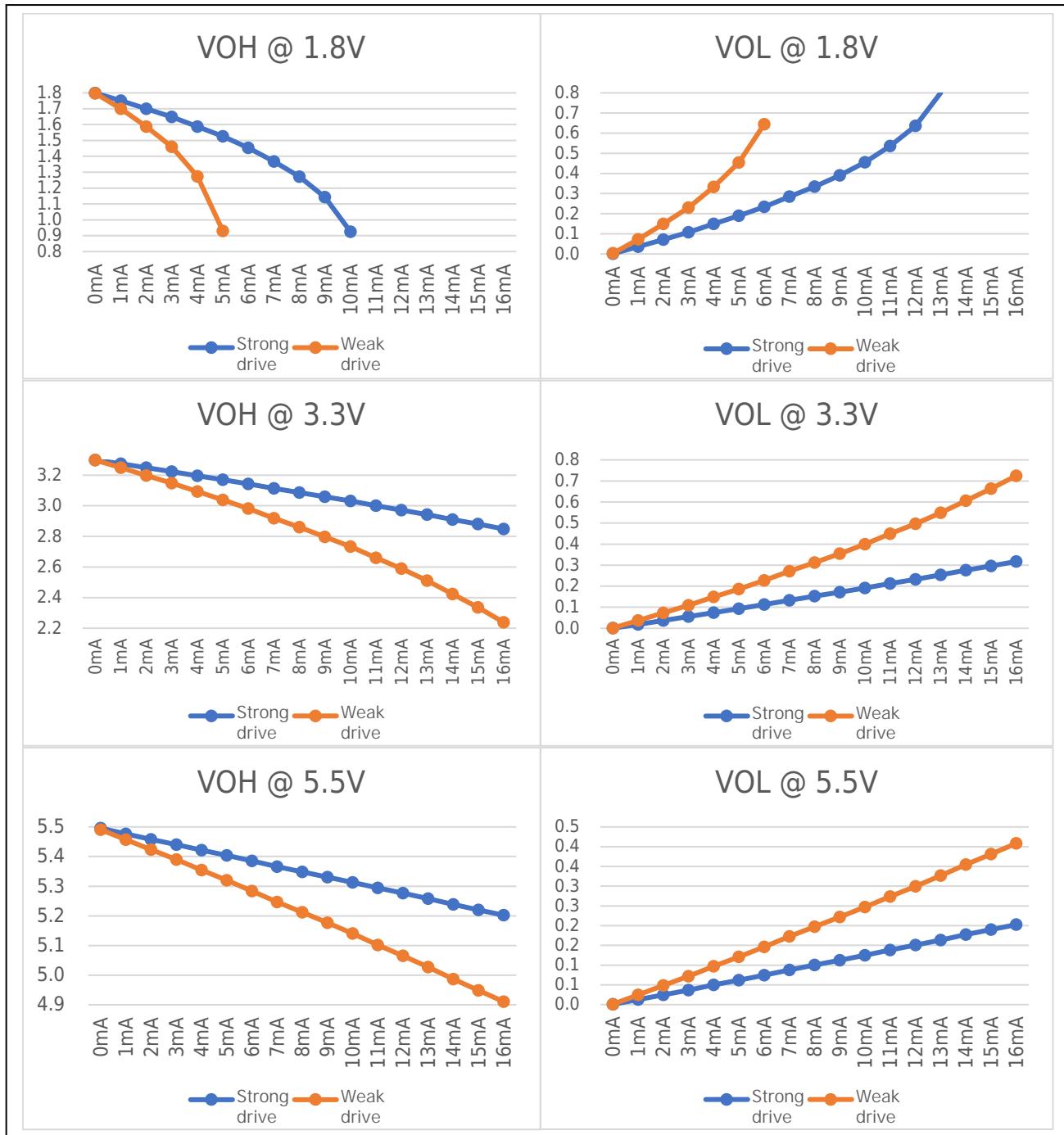
### 7.3.13 I/O Port Characteristics

#### 7.3.13.1 Output Characteristics - Ports

Table 7-9 Port output characteristics

Symbol	Parameter	Conditions	Min	Max	Units
V <sub>OH</sub>	High level output voltage Source Current	Sourcing 4 mA, VCC = 3.3 V (see Note 1)	VCC-0.25		V
		Sourcing 8 mA, VCC = 3.3 V (see Note 2)	VCC-0.6		V
V <sub>OL</sub>	Low level output voltage Sink Current	Sinking 5 mA, VCC = 3.3 V (see Note 1)		VSS+0.25	V
		Sinking 14 mA, VCC = 3.3 V (see Note 2)		VSS+0.6	V
V <sub>OHD</sub>	High level output voltage Double source Current	Sourcing 8 mA, VCC = 3.3 V (see Note 1)	VCC-0.25		V
		Sourcing 18 mA, VCC = 3.3V (see Note 2)	VCC-0.6		V
V <sub>OLD</sub>	Low level output voltage Double Sink Current	Sinking 8 mA, VCC = 3.3 V (see Note 1)		VSS+0.25	V
		Sinking 18 mA, VCC = 3.3 V (see Note 2)		VSS+0.6	V

NOTES: 1. The maximum total current,  $I_{OH(max)}$  and  $I_{OL(max)}$ , for all outputs combined, should not exceed 40 mA to satisfy the maximum specified voltage drop.  
 2. The maximum total current,  $I_{OH(max)}$  and  $I_{OL(max)}$ , for all outputs combined, should not exceed 100 mA to satisfy the maximum specified voltage drop.



**Figure 7-2 Output port VOH/VOL measured curve**

### 7.3.13.2 Input characteristics - ports PA, PB, PC, PD, PE, PF

符号	参数	条件	最小值	典型值	最大值	单位
$V_{IH}$	Positive-going input threshold voltage	VCC=1.8V	0.7VCC			V
		VCC=3.3V	0.7VCC			V
		VCC=5.5V	0.7VCC			V
$V_{IL}$	Negative-going input threshold voltage	VCC=1.8V			0.3VCC	V
		VCC=3.3V			0.3VCC	V
		VCC=5.5V			0.3VCC	V
$V_{hys(1)}$	Input voltage hysteresis ( $V_{IH} - V_{IL}$ )	VCC=1.8V		0.3		V
		VCC=3.3V		0.4		V
		VCC=5.5V		0.6		V
$R_{pullhigh}$ (GPIO)	Pullup resistor	Pullup enabled VCC=3.3V		80		kΩ
$R_{pulllow}$ (GPIO)	Pulldown resistor	Pulldown enabled VCC=3.3V		40		kΩ
$C_{input}$	Input capacitance			5		pf

1. 由综合评估得出，不在生产中测试。

### 7.3.13.3 Input characteristics - USB\_DP, USB\_DM

符号	参数	条件	最小值	典型值	最大值	单位
$V_{IH}$	Positive-going input threshold voltage	AVCC_USB = 3.0 ~ 3.6	0.7AVCC_USB			V
$V_{IL}$	Negative-going input threshold voltage				0.3AVCC_USB	V
$V_{hys(1)}$	Input voltage hysteresis ( $V_{IH} - V_{IL}$ )			0.3		V
$R_{pullhigh}$	Pullup resistor	Transmitting	1425		3090	Ohm
		Idle	900		1575	
$C_{input}$	Input capacitance			5		pf

1. 由综合评估得出，不在生产中测试。

### 7.3.13.4 Port External Input Sampling Requirements - Timer Gate/Timer Clock

符号	参数	条件	最小值	典型值	最大值	单位
t(int)	External interrupt timing	External trigger signal for the interrupt flag (see Note 1)	1.8V	30		ns
			3.3V	30		ns
			5.5V	30		ns
t(cap)	Timer capture timing	Timer4/5/6 capture pulse width Fsystem = 4MHz	1.8V	0.5		μs
			3.3V	0.5		μs
			5.5V	0.5		μs
t(clk)	Timer clock frequency applied to pin	Timer0/1/2/4/5/6 external clock input Fsystem = 4MHz	1.8V		PCLK/2	MHz
			3.3V		PCLK/2	MHz
			5.5V		PCLK/2	MHz
t(pca) <sup>(2)</sup>	PCA clock frequency applied to pin	PCA external clock input Fsystem = 4MHz	1.8V		PCLK/8	MHz
			3.3V		PCLK/8	MHz
			5.5V		PCLK/8	MHz

NOTES: 1. The external signal sets the interrupt flag every time the minimum t<sub>(int)</sub> parameters are met. It may be set even with trigger signals shorter than t<sub>(int)</sub>.

2. 由综合评估得出，不在生产中测试。

### 7.3.13.5 Port leakage characteristics - PA, PB, PC, PD, PE, PF

符号	参数	条件	最小值	典型值	最大值	单位
I <sub>lk</sub> (Px,y)	Leakage current	V <sub>(Px,y)</sub> (see Note 1, 2)		±50		nA

NOTES: 1. The leakage current is measured with VSS or VCC applied to the corresponding pin(s), unless otherwise noted.

2. The port pin must be selected as input.

### 7.3.14 RESETB Pin Characteristics

RESETB 引脚输入驱动使用 CMOS 工艺，它连接了一个不能断开的上拉电阻。

符号	参数	条件	最小值	典型值	最大值	单位
VIL(RESETB) <sup>(1)</sup>	输入低电平电压		-0.3		0.3VCC	V
VIH(RESETB)	输入高电平电压		0.7VCC		VCC+0.3	V
V <sub>hys</sub> (RESETB)	施密特触发器电压迟滞			200		mV
R <sub>PU</sub>	弱上拉等效电阻	V <sub>IN</sub> = V <sub>SS</sub>		80		KΩ
T <sub>F</sub> (RESETB) <sup>(1)</sup>	输入滤波脉冲				2	μs
T <sub>NF</sub> (RESETB) <sup>(1)</sup>	输入非滤波脉冲		10			μs

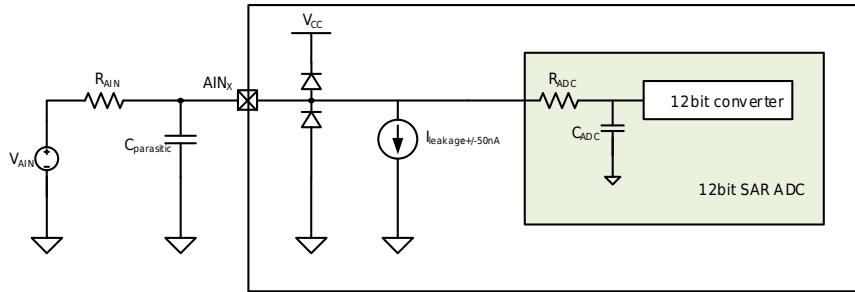
- 由设计保证，不在生产中测试。

### 7.3.15 ADC Characteristics

符号	参数	条件	最小值	典型值	最大值	单位
V <sub>ADCIN</sub>	Input voltage range	Single ended	0		V <sub>ADCREFIN</sub>	V
V <sub>ADCREFIN</sub>	Input range of external reference voltage	Single ended	0		AVCC	V
DEV <sub>AVCC/3</sub>	AVCC/3 精度			3		%
I <sub>ADC1</sub>	Active current including reference generator and buffer	200Ksps		2		mA
I <sub>ADC2</sub>	Active current without reference generator and buffer	1Msps		0.5		mA
C <sub>ADCIN</sub>	ADC input capacitance			16	19.2	pF
R <sub>ADC</sub> <sup>(1)</sup>	ADC sampling switch impedance			1.5		kΩ
R <sub>AIN</sub> <sup>(1)</sup>	ADC external input resistor <sup>(2)</sup>				100	kΩ
F <sub>ADCCLK</sub>	ADC clock Frequency				24M	Hz
T <sub>ADCSTART</sub>	Startup time of reference generator and ADC core			30		μs
T <sub>ADCCONV</sub>	Conversion time		20	24	28	cycles
ENOB	Effective Bits	1Msps@VCC>=2.7V 500Ksps@VCC>=2.4V 200Ksps@VCC>=1.8V REF=EXREF		10.3		Bit
		1Msps@VCC>=2.7V 500Ksps@VCC>=2.4V 200Ksps@VCC>=1.8V REF=VCC		10.3		Bit
		200Ksps@VCC>=1.8V REF=internal 1.5V		9.4		Bit
		200Ksps@VCC>=2.8V REF=internal 2.5V		9.4		Bit
SNR	Signal to Noise Ratio	1Msps@VCC>=2.7V 500Ksps@VCC>=2.4V 200Ksps@VCC>=1.8V REF=EXREF		68.2		dB
		1Msps@VCC>=2.7V 500Ksps@VCC>=2.4V 200Ksps@VCC>=1.8V REF=VCC		68.2		dB
		200Ksps@VCC>=1.8V REF=internal 1.5V		60		dB
		200Ksps@VCC>=2.8V REF=internal 2.5V		60		dB
DNL <sup>(1)</sup>	Differential non-linearity	200Ksps; VREF=EXREF/AVCC	-1		1	LSB
INL <sup>(1)</sup>	Integral non-linearity	200Ksps; VREF=EXREF/AVCC	-3		3	LSB
E <sub>o</sub>	Offset error			0		LSB
E <sub>g</sub>	Gain error			0		LSB

1. 由设计保证，不在生产中测试。

2. ADC 的典型应用如下图所示：



对于 0.5LSB 采样误差精度要求的条件下，外部输入阻抗的计算公式如下：

$$R_{AIN} = \frac{M}{F_{ADC} * C_{ADC} * (N+1) * \ln(2)} - R_{ADC}$$

其中  $F_{ADC}$  为 ADC 时钟频率，寄存器  $ADC\_CR0<3:2>$  可设定其与 PCLK 的关系，如下表。

下表为 ADC 时钟频率  $F_{ADC}$  和 PCLK 分频比关系：

$ADC\_CR0<3:2>$	N
00	1
01	2
10	4
11	8

M 为采样周期个数，由寄存器  $ADC\_CR0<13:12>$  设定。

下表为采样时间  $t_{sa}$  和 ADC 时钟频率  $F_{ADC}$  的关系：

$ADC\_CR0<13:12>$	M
00	4
01	6
10	8
11	12

下表为 ADC 时钟频率  $F_{ADC}$  和外部电阻  $R_{AIN}$  的关系 (M=12, 采样误差 0.5LSB 的条件下)：

$R_{AIN}$ (kΩ)	$F_{ADC}$ (kHz)
10	5600
30	2100
50	1300
80	820
100	660
120	550
150	450

对于上述典型应用，应注意：

- 尽量减小 ADC 输入端口  $AIN_X$  的寄生电容  $C_{PARACITIC}$ ；
- 除了考虑  $R_{AIN}$  值外，如果信号源  $V_{AIN}$  的内阻较大时，也需要加入考虑。

### 7.3.16 VC Characteristics

符号	参数	条件	最小值	典型值	最大值	单位
Vin	Input voltage range		0		5.5	V
Vincom	Input common mode range		0		VCC-0.2	V
Voffset	Input offset	常温 25°C 3.3V	-10		+10	mV
Icomp	Comparator's current	VCx_BIAS_SEL=00		0.3		
		VCx_BIAS_SEL=01		1.2		
		VCx_BIAS_SEL=10		10		
		VCx_BIAS_SEL=11		20		μA
Tresponse	Comparator's response time when one input cross another	VCx_BIAS_SEL=00		20		
		VCx_BIAS_SEL=01		5		
		VCx_BIAS_SEL=10		1		μs
		VCx_BIAS_SEL=11		0.2		
Tsetup	Comparator's setup time when ENABLE. Input signals unchanged.	VCx_BIAS_SEL=00		20		
		VCx_BIAS_SEL=01		5		
		VCx_BIAS_SEL=10		1		μs
		VCx_BIAS_SEL=11		0.2		
Twarmup	From main bandgap enable to Temp sensor voltage, ADC internal 1.5V, 2.5V reference stable			20		
						μs
Tfilter	Digital filter time	VC_debounce = 000		7		
		VC_debounce = 001		14		
		VC_debounce = 010		28		
		VC_debounce = 011		112		
		VC_debounce = 100		450		
		VC_debounce = 101		1800		
		VC_debounce = 110		7200		
		VC_debounce = 111		28800		

### 7.3.17 OPA Features

OPA: (AVCC=2.2 ~ 5.5 V, AVSS=0 V, Ta=-40 ~ +85°C)

符号	参数	条件	最小值	典型值	最大值	单位
Vi	输入电压		0	-	AVCC	V
Vo	输出电压 <sup>(1)</sup>		0.1	-	AVCC-0.2	V
Io	输出电流 <sup>(1)</sup>				2.2	mA
RL	负载电阻 <sup>(1)</sup>		5K			Ohm
Tstart	初始化时间 <sup>(2)</sup>				20	μs
Vio	输入失调电压	ViC=AVCC/2, Vo=AVCC/2, RL=5kΩ, RS=50 pF		±6		mV
PM	相位裕度 <sup>(1)</sup>	ViC=AVCC/2, Vo=AVCC/2 RL=5kΩ, CL=50pF		80	-	deg
UGBW	单位增益带宽 <sup>(1)</sup>	ViC=AVCC/2, Vo=AVCC/2 RL=5kΩ, CL=50pF		9.3		MHz
SR	压摆率 <sup>(1)</sup>	RL=5kΩ, CL=50pF		8		V/μs

1. 由设计保证，不在生产中测试。
2. 需要同时设置 BGR\_CR<0>=1

### 7.3.18 LCD Controller

符号	参数	工作条件	最小值	典型值	最大值	单位
$I_{LCD}$	工作电流	VCC=3.3V, 外部电容模式		0.2		$\mu A$
		VCC=3.3V, 外部电阻模式		0.2		$\mu A$
		VCC=3.3V, 内部电阻模式		3.3		$\mu A$
$R_H$	低驱动电阻			1M		$\Omega$
$R_L$	高驱动电阻			360K		$\Omega$
$V_{LCDH}$	LCD 可调最高电压			VCC	V	
$V_{LCD3}$	LCD 最高电压			VLCDH	V	
$V_{LCD2}$	LCD 2/3 电压			2/3 VLCDH	V	
$V_{LCD1}$	LCD 1/3 电压			1/3 VLCDH	V	
$V_{LCD0}$	LCD 最低电压		0			V
$\Delta V_{XX}$	LCD 电压偏差	$T_A=-40\sim85^\circ C$		$\pm 5\%$		

### 7.3.19 DAC Characteristics

符号	参数	工作条件	最小值	典型值	最大值	单位
$V_{DACOUT}$	Output voltage range	AVCC voltage reference , single ended	0		Vcc	V
$V_{DACCm}$	Output common mode voltage range		0		Vcc	V
$I_{DAC}$	Active current	500KSamples/s		15		$\mu A$
$SR_{DAC}$	Sample rate			500	Ksps	
$t_{DACCONV}$	Conversion time		2			$\mu s$
$t_{DACSETTLE}$	Setting time			5		$\mu s$
$SNR_{DAC}$	Signal to Noise Ratio			59		dB
$SNDR_{DAC}$	Signal to Noise and Distortion Ratio			57		dB
$SFDR_{DAC}$	Spurious Free Dynamic Range			56		dB
$V_{DACOFFSET}$	Offset voltage	w/o buffer		2		mV
$DNL_{DAC}$	Differential non-linearity			$\pm 1$		LSB
$INL_{DAC}$	Integral non-linearity			$\pm 5$		LSB

### 7.3.20 TIM timer characteristics

有关输入输出复用功能引脚（输出比较、输入捕获、外部时钟、PWM 输出）的特性详情，参见下表。

表 7-10 高级定时器 (ADVTIM) 特性

符号	参数	条件	最小值	最大值	单位
$t_{res}$	定时器分辨时间		1		$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	20.8		ns
$f_{ext}$	外部时钟频率		0	$f_{TIMCLK}/2$	MHz
		$f_{TIMCLK}=48MHz$	0	24	MHz
$Res_{Tim}$	定时器分辨率			16	位
$T_{counter}$	选择内部时钟时，16 位计数器时钟周期		1	65536	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	0.0208	1363	$\mu s$
$T_{MAX\_COUNT}$	最大可能计数			67108864	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$		1.4	s

1. 由设计保证，不在生产中测试。

表 7-11 通用定时器特性

符号	参数	条件	最小值	最大值	单位
$t_{res}$	定时器分辨时间		1		$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	20.8		ns
$f_{ext}$	外部时钟频率		0	$f_{TIMCLK}/2$	MHz
		$f_{TIMCLK}=48MHz$	0	24	MHz
$Res_{Tim}$	定时器分辨率			16	位
		模式 0 自由计数		32	位
$T_{counter}$	选择内部时钟时，16 位计数器时钟周期		1	65536	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	0.0208	1363	$\mu s$
$T_{MAX\_COUNT}$	最大可能计数			16777216	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$		349.5	ms

1. 由设计保证，不在生产中测试。

表 7-12 PCA 特性

符号	参数	条件	最小值	最大值	单位
$t_{res}$	定时器分辨时间		1		$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	20.8		ns
$f_{ext}$	外部时钟频率		0	$f_{TIMCLK}/2$	MHz
		$f_{TIMCLK}=48MHz$	0	24	MHz
$Res_{Tim}$	定时器分辨率			16	位
$T_{counter}$	选择内部时钟时，16 位计数器时钟周期		1	65536	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	0.0208	1363	$\mu s$
$T_{MAX\_COUNT}$	最大可能计数			2097152	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$		43.69	ms

1. 由设计保证，不在生产中测试。

表 7-13 低功耗定时器特性

符号	参数	条件	最小值	最大值	单位
$t_{res}$	定时器分辨时间		1		$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	20.8		ns
$f_{ext}$	外部时钟频率		0	$f_{TIMCLK}/2$	MHz
		$f_{TIMCLK}=48MHz$	0	24	MHz
$Res_{Tim}$	定时器分辨率			16	位
$T_{counter}$	选择内部时钟时，16 位计数器时钟周期		1	65536	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$	0.0208	1363	$\mu s$
$T_{MAX\_COUNT}$	最大可能计数			16777216	$t_{TIMCLK}$
		$f_{TIMCLK}=48MHz$		349.53	ms

1. 由设计保证，不在生产中测试。

表 7-14 WDT 特性

符号	参数	条件	最小值	最大值	单位
$t_{res}$	WDT 溢出时间	$f_{WDTCLK}=10kHz$	1.6	52000	ms

1. 由设计保证，不在生产中测试。

### 7.3.21 Communication interfaces

#### 7.3.21.1 I2C Features

I2C 接口特性如下表：

表 7-15 I2C 接口特性

符号	参数	标准模式 (100K)		快速模式 (400K)		高速模式 (1M)		单位
		最小值	最大值	最小值	最大值	最小值	最大值	
tSCLL	SCL 时钟低时间	4.7		1.25		0.5		μs
tSCLH	SCL 时钟高时间	4.0		0.6		0.26		μs
tsu.SDA	SDA 建立时间	250		100		50		ns
tHD.SDA	SDA 保持时间	0		0		0		μs
tHD.STA	开始条件保持时间	2.5		0.625		0.25		μs
tsu.STA	重复的开始条件建立时间	2.5		0.6		0.25		μs
tsu.STO	停止条件建立时间	0.25		0.25		0.25		μs
tBUF	总线空闲(停止条件至开始条件)	4.7		1.3		0.5		μs

- 由设计保证，不在生产中测试。

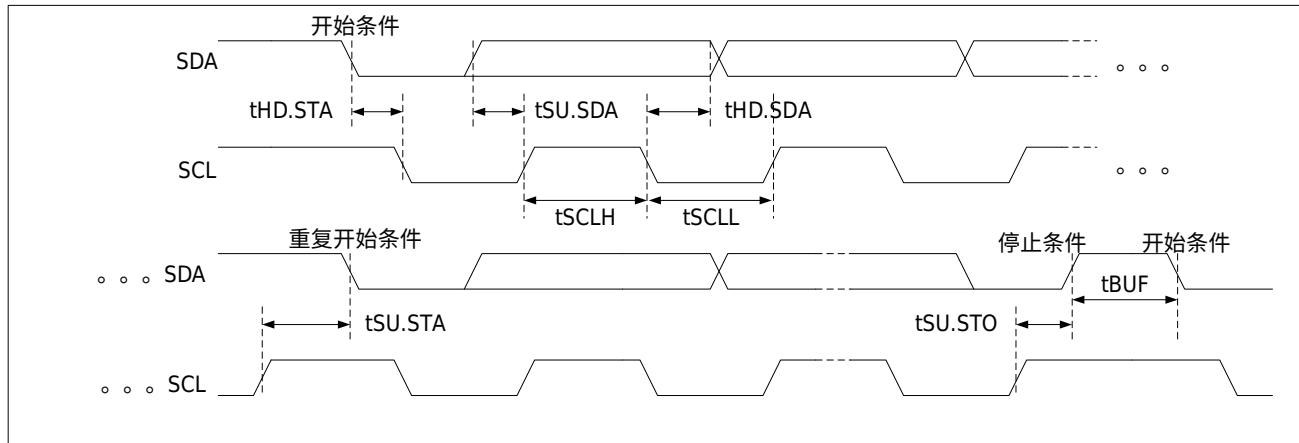


图 7-3 I2C 接口时序

### 7.3.21.2 SPI Features

表 7-16 SPI 接口特性<sup>(1) (2)</sup>

符号	参数	条件	最小值	最大值	单位
$t_c(SCK)$	串行时钟的周期 <sup>(3)</sup>	主机发送模式 $f_{PCLK} = 32\text{MHz}$	62.5	-	ns
		主机接收模式 $f_{PCLK} = 48\text{MHz}$	160	-	ns
		从机发送模式 $f_{PCLK} = 48\text{MHz}$	160	-	ns
		从机接收模式 $f_{PCLK} = 48\text{MHz}$	84	-	ns
$t_w(SCKH)$	串行时钟的高电平时间	主机模式	$0.45 \times t_c(SCK)$	-	ns
		从机模式	$0.45 \times t_c(SCK)$	-	ns
$t_w(SCKL)$	串行时钟的低电平时间	主机模式	$0.45 \times t_c(SCK)$	-	ns
		从机模式	$0.45 \times t_c(SCK)$	-	ns
$t_{su(SSN)}$	从机选择的建立时间	从机模式	$0.45 \times t_c(SCK)$	-	ns
$t_h(SSN)$	从机选择的保持时间	从机模式	$0.45 \times t_c(SCK)$	-	ns
$t_v(MO)$	主机数据输出的生效时间	-	-	3	ns
$t_h(MO)$	主机数据输出的保持时间	-	2	-	ns
$t_v(SO)$	从机数据输出的生效时间	-	-	$20+1.5*T_{PCLK}$	ns
$t_h(SO)$	从机数据输出的保持时间	-	$10+0.5*T_{PCLK}$	-	ns
$t_{su(MI)}$	主机数据输入的建立时间	-	10	-	ns
$t_h(MI)$	主机数据输入的保持时间	-	2	-	ns
$t_{su(SI)}$	从机数据输入的建立时间	-	10	-	ns
$t_h(SI)$	从机数据输入的保持时间	-	2	-	ns

1. 由设计保证，不在生产中测试。
2. 数据基于VCC=3.0V条件给出。
3. 主机模式最大分频系数为PCLK/2，从机模式最大分频系数为PCLK/4。

SPI 接口信号的波形和时序参数如下：

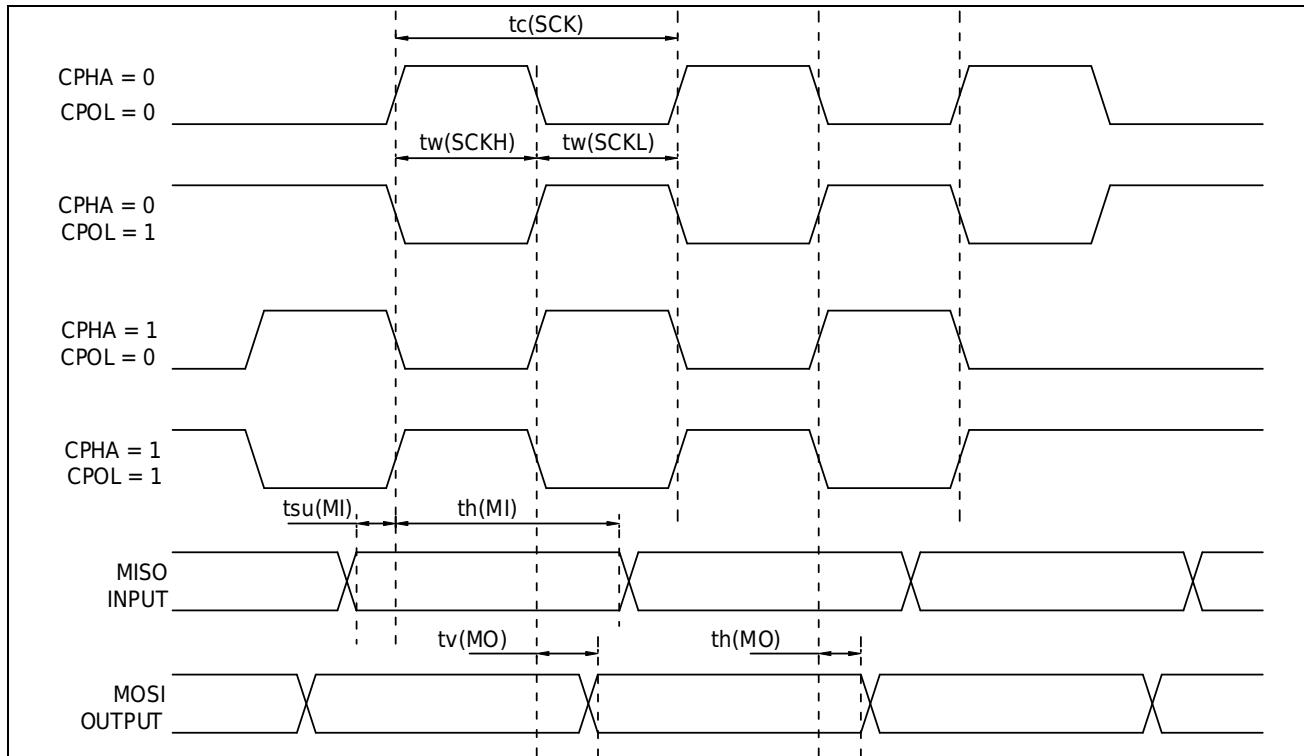


图 7-4 SPI 时序图 (主机模式)

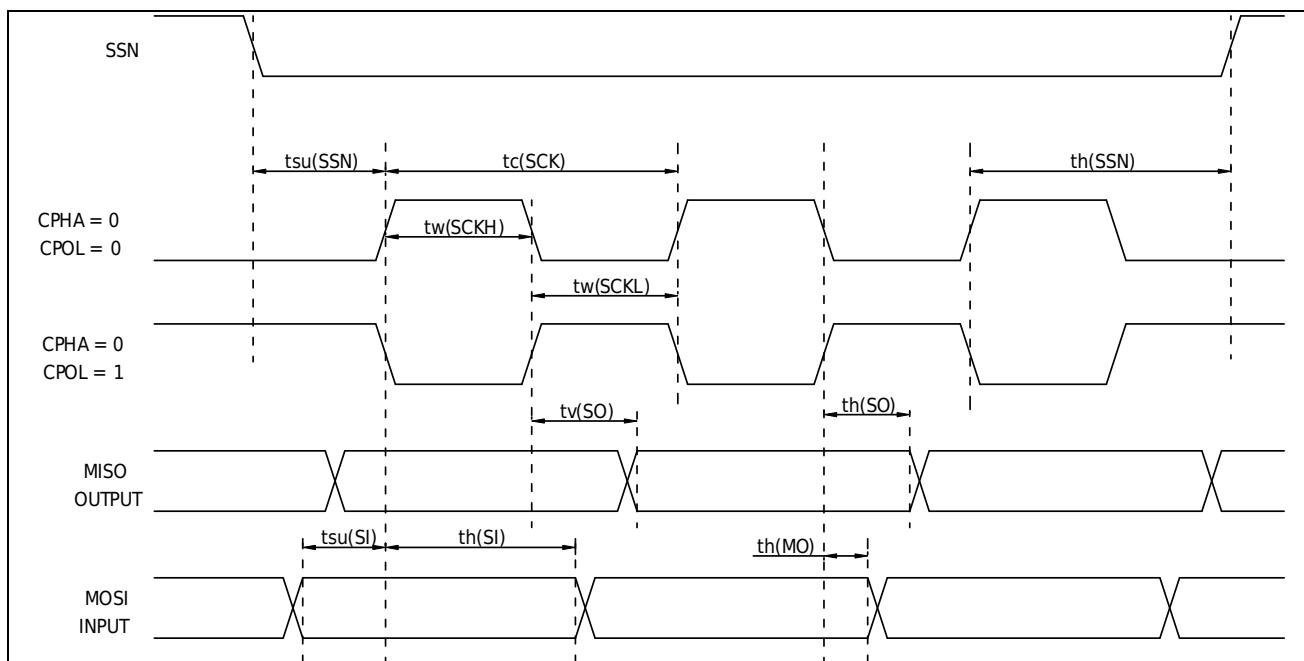


图 7-5 SPI 时序图 (从机模式 cpha=0)

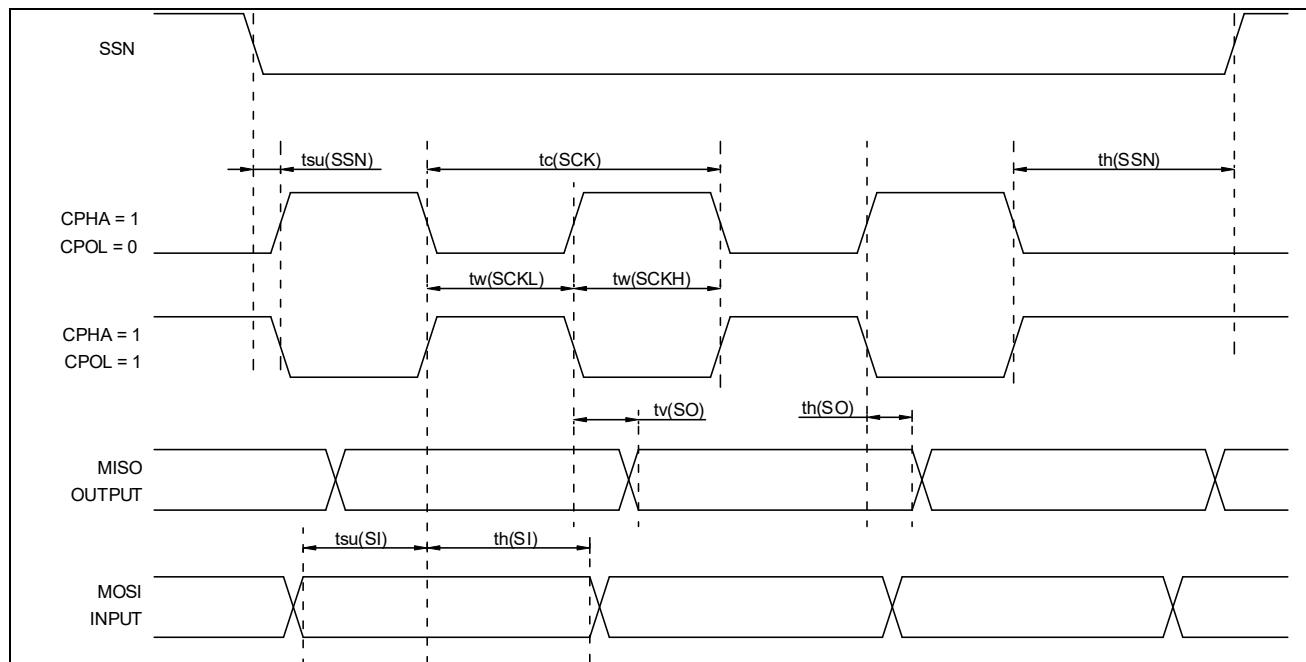
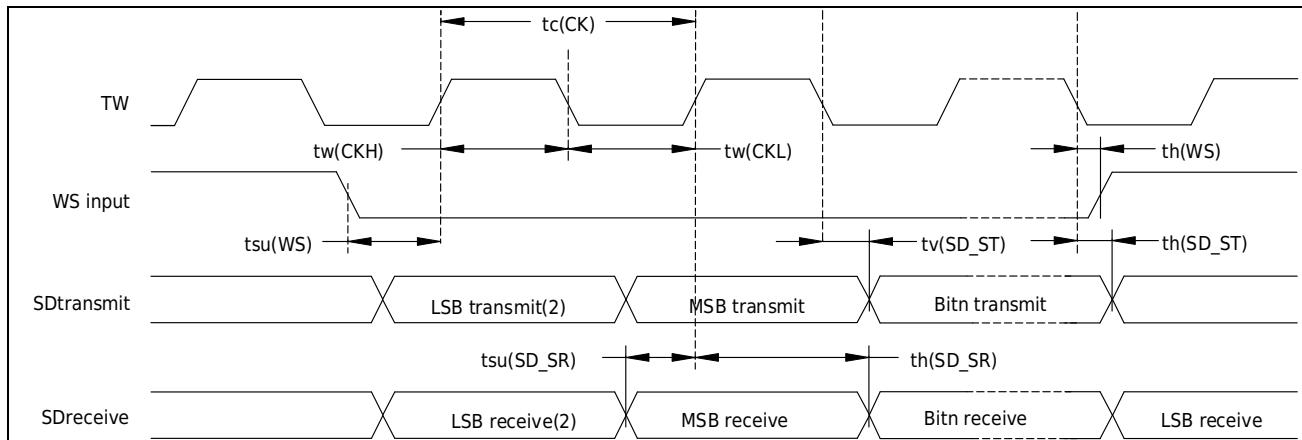


图 7-6 SPI 时序图 (从机模式 cpha=1)

### 7.3.21.3 I2S Features<sup>(1)</sup>

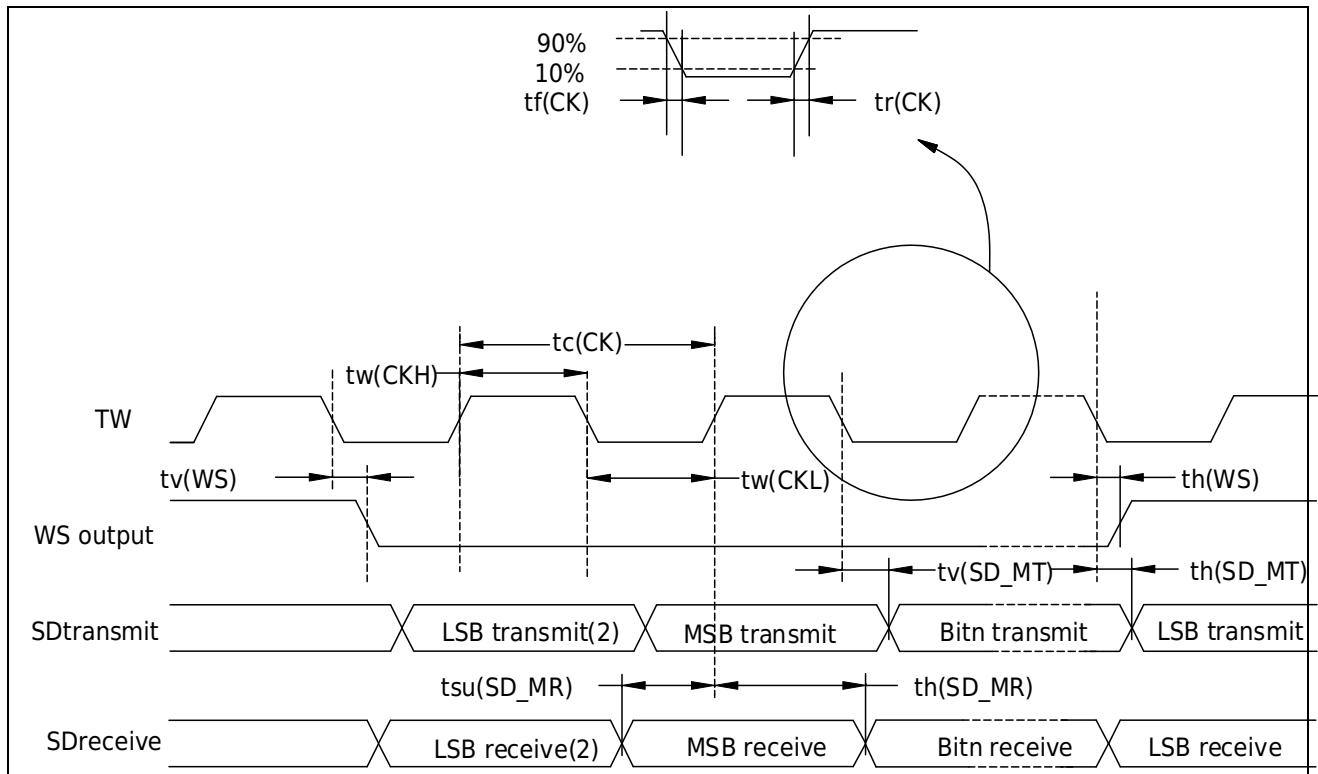
符号	参数	条件	最小值	最大值	单位
$f_{ck}$	I2S 时钟频率	Master mode (data:16bits, audio freq 48kHz)	1.597	1.601	MHz
		Slave mode	0	6.5	
$t_{r(ck)}$	I2S 时钟上升时间	Capacitive load $C_L=15\text{pF}$	-	10	ns
$T_{f(ck)}$	I2S 时钟下降时间		-	12	
$t_{w(ckh)}$	I2S 时钟高电平时间	Master $f_{pclk}=16\text{MHz}$ , audio freq 48kHz	306	-	
$t_{w(ckl)}$	I2S 时钟低电平时间		312	-	
$t_{v(ws)}$	WS 有效时间	Master mode	2	-	
$T_h(ws)$	WS 保持时间	Master mode	2	-	
$T_{su(ws)}$	WS 建立时间	Slave mode	7	-	
$T_h(ws)$	WS 保持时间	Slave mode	0	-	
Duty(sck)	从模式时钟占空比	Slave mode	25	75	%
$T_{su(SD\_MR)}$	SD 输入建立时间	Master receiver	6	-	ns
$T_{su(SD\_SR)}$		Slave receiver	2	-	
$T_h(SD\_MR)$ <sup>(2)</sup>	SD 输入保持时间	Master receiver	4	-	
$T_h(SD\_SR)$ <sup>(2)</sup>		Slave receiver	0.5	-	
$T_v(SD\_MR)$ <sup>(2)</sup>	SD 输出建立时间	Master transmitter	-	4	
$T_v(SD\_SR)$ <sup>(2)</sup>		Slave transmitter	-	20	
$T_h(SD\_MR)$	SD 输出保持时间	Master transmitter	0	-	
$T_h(SD\_SR)$		Slave transmitter	13	-	

1. 由设计保证，不在生产中测试。
2. 与  $F_{PCLK}$  相关，例如  $F_{PCLK}=10\text{M}$   $T_{PCLK}=1/F_{PCLK}=100\text{ns}$



1. Measurement points are done at CMOS levels:  $0.3 \times V_{DDIOX}$  and  $0.7 \times V_{DDIOX}$ .
2. LSB transmit/receive of the previously transmitted byte. No LSB transmit/receive is sent before the first byte.

图 7-7 I2S slave timing diagram



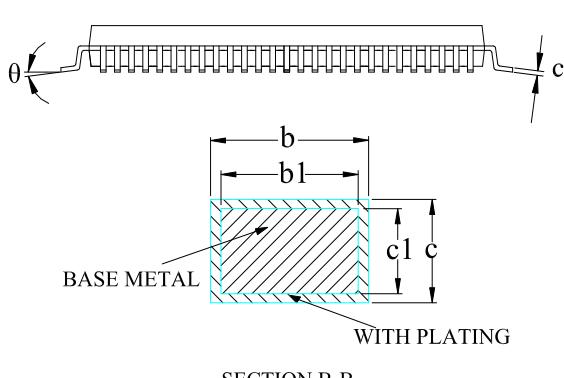
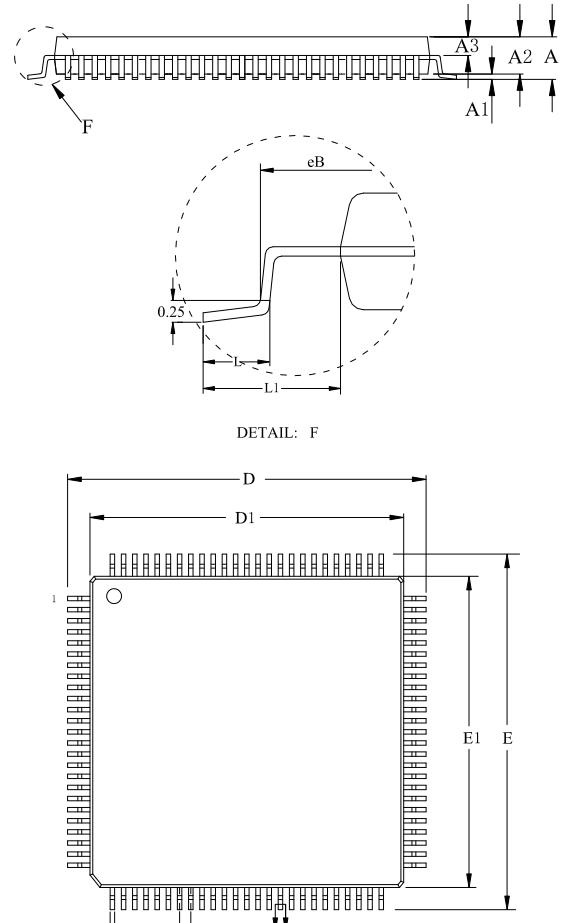
1. Data based on characterization results, not tested in production.
2. LSB transmit/receive of the previously transmitted byte. No LSB transmit/receive is sent before the first byte.

图 7-8 I2S master timing diagram

## 8 Packaging Information

### 8.1 Package Dimensions

LQFP100 package

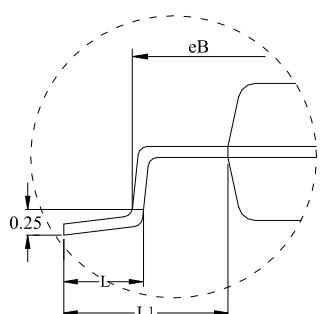
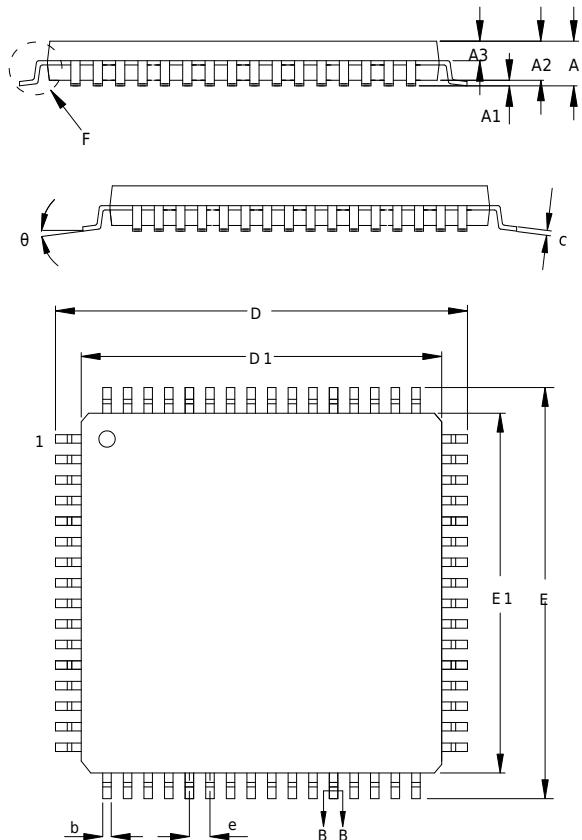


Symbol	14 x 14 Millimeter		
	Min	Nom	Max
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
A3	0.59	0.64	0.69
b	0.18	--	0.26
b1	0.17	0.20	0.23
c	0.13	--	0.17
c1	0.12	0.13	0.14
D	15.80	16.00	16.20
D1	13.90	14.00	14.10
E	15.80	16.00	16.20
E1	13.90	14.00	14.10
eB	15.05	--	15.35
e	0.50BSC		
L	0.45	--	0.75
L1	1.00REF		
θ	0	--	7°

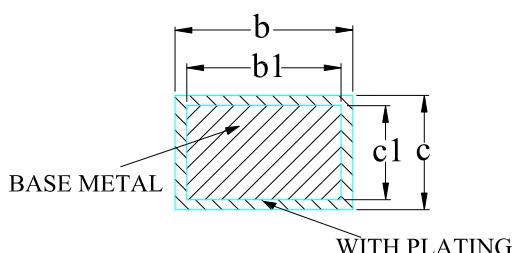
#### NOTE

- Dimensions "D1" and "E1" do not include mold flash.

LQFP64 package



DETAIL: F



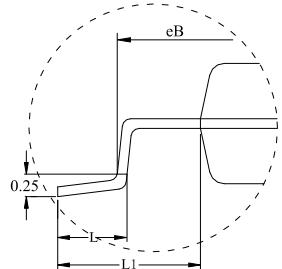
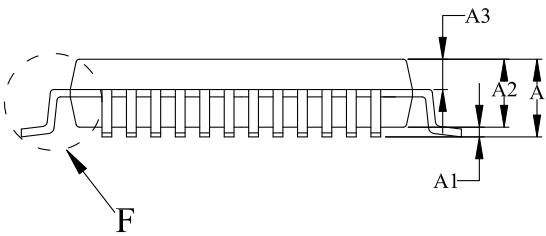
SECTION B-B

Symbol	10 x 10 Millimeter		
	Min	Nom	Max
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
A3	0.59	0.64	0.69
b	0.18	--	0.26
b1	0.17	0.20	0.23
c	0.13	--	0.17
c1	0.12	0.13	0.14
D	11.80	12.00	12.20
D1	9.90	10.00	10.10
E	11.80	12.00	12.20
E1	9.90	10.00	10.10
eB	11.05	--	11.25
e	0.50BSC		
L	0.45	--	0.75
L1	1.00REF		
$\theta$	0°	--	7°

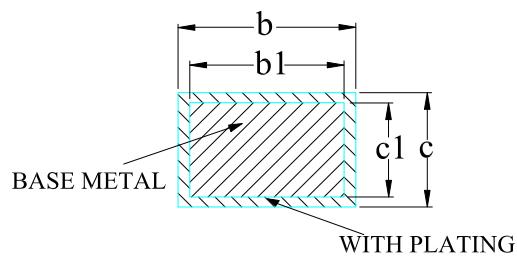
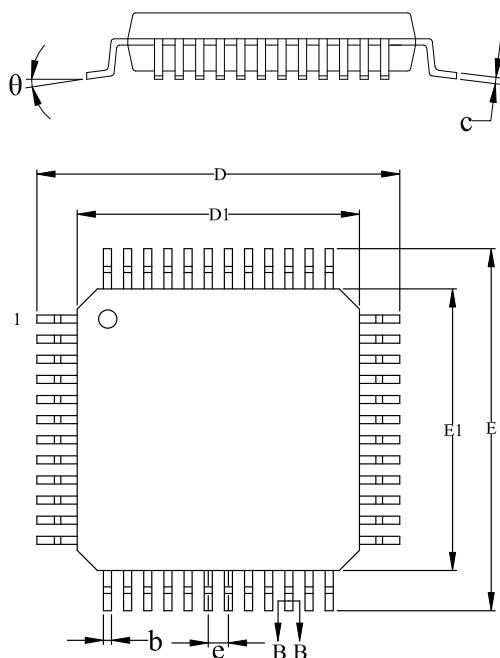
**NOTE**

- Dimensions "D1" and "E1" do not include mold flash.

LQFP48 package



DETAIL: F



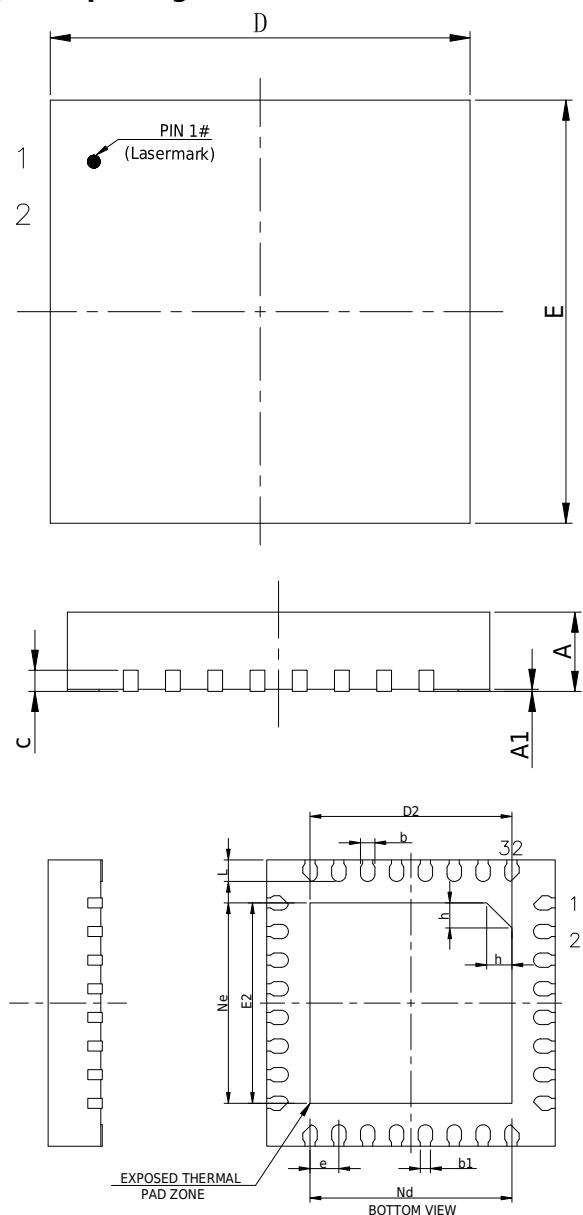
SECTION B-B

Symbol	7 x 7 Millimeter		
	Min	Nom	Max
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
A3	0.59	0.64	0.69
b	0.18	--	0.26
b1	0.17	0.20	0.23
c	0.13	--	0.17
c1	0.12	0.13	0.14
D	8.80	9.00	9.20
D1	6.90	7.00	7.10
E	8.80	9.00	9.20
E1	6.90	7.00	7.10
$e_B$	8.10	--	8.25
e	0.50BSC		
L	0.40	--	0.65
$L_1$	1.00REF		
$\theta$	0	--	7°

**NOTE**

- Dimensions "D1" and "E1" do not include mold flash.

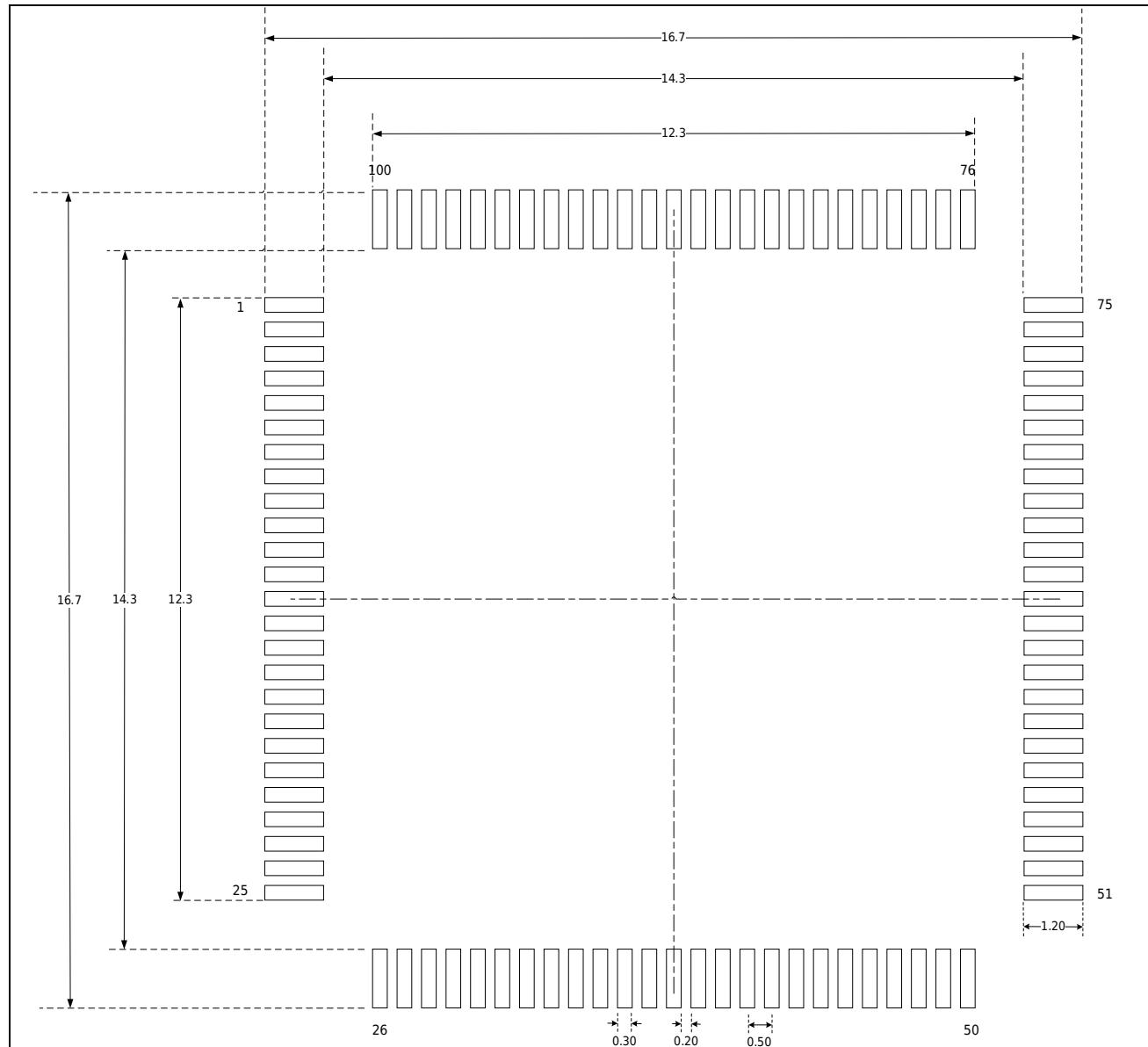
**QFN32 package**



Symbol	5 x 5 Millimeter		
	Min	Nom	Max
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
b	0.20	0.25	0.30
b1	0.16REF		
c	0.18	0.20	0.25
D	4.90	5.00	5.10
D2	3.70	3.80	3.90
e	0.50BSC		
Ne	3.50BSC		
Nd	3.50BSC		
E	4.90	5.00	5.10
E2	3.70	3.80	3.90
L	0.25	0.30	0.35
h	0.30	0.35	0.40
L/F 载体尺寸	4.10 x 4.10		

## 8.2 Pad Diagram

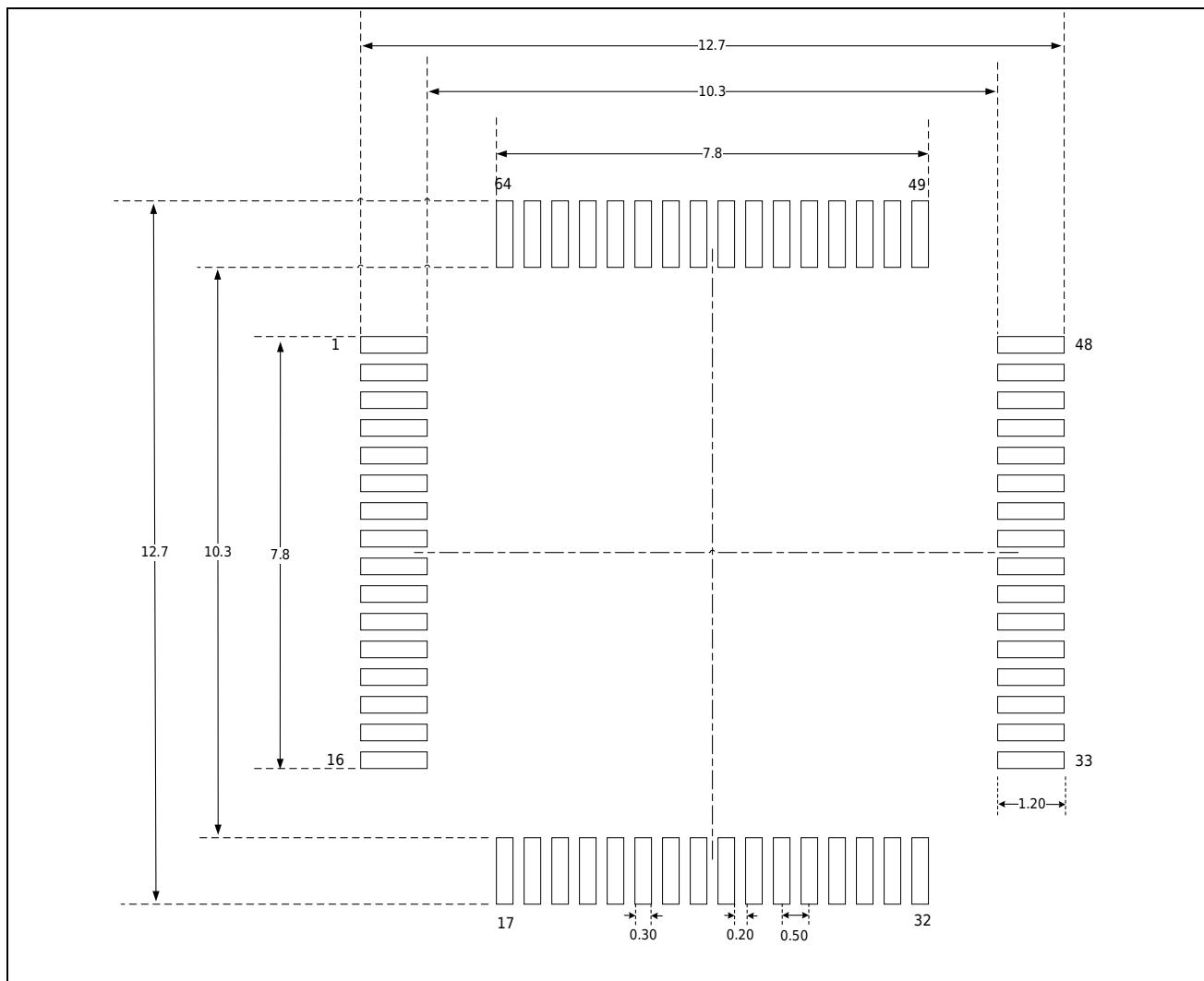
## **LQFP100 package (14mm x 14mm)**



## **NOTE**

- Dimensions are expressed in millimeters.
  - 尺寸仅做参考。

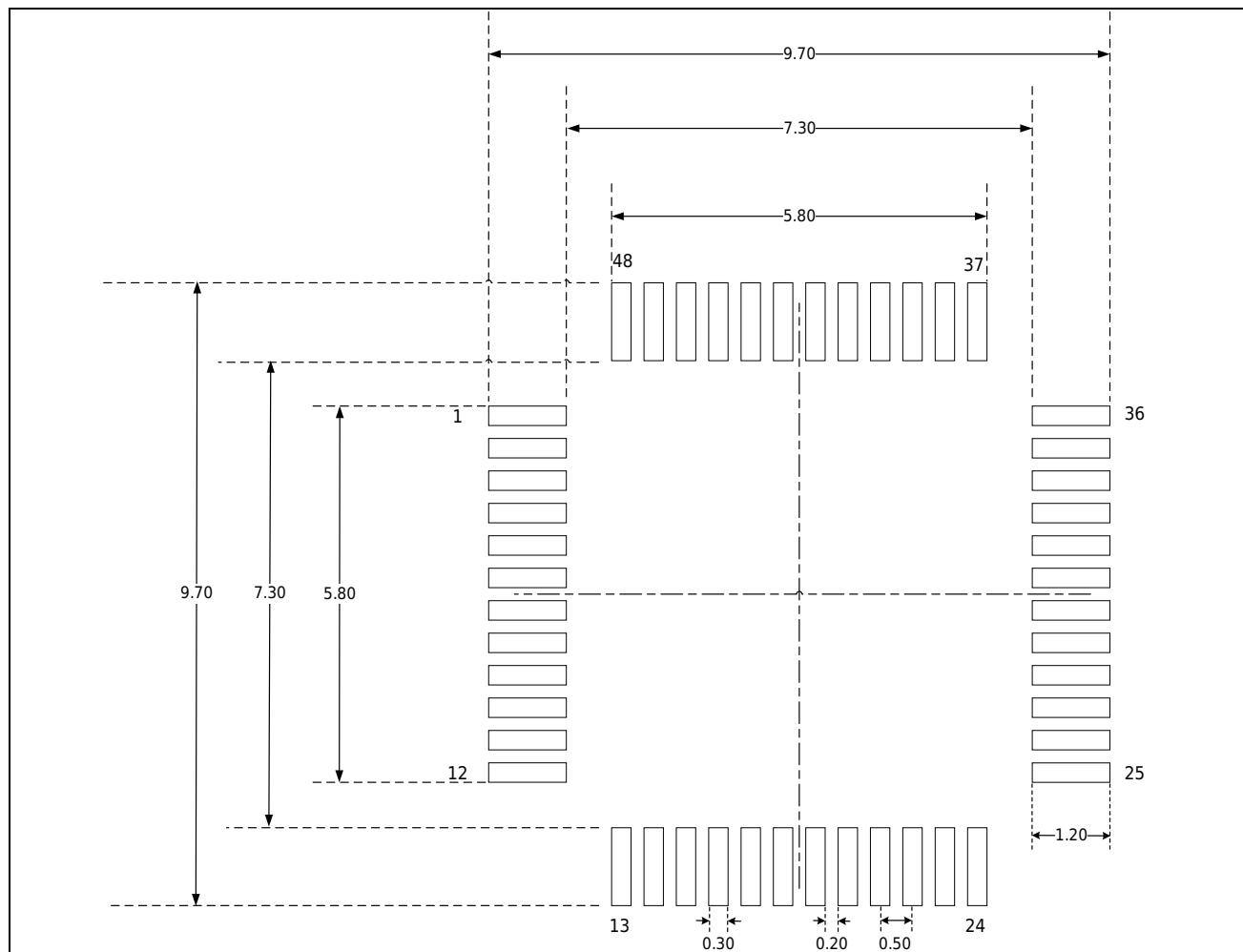
**LQFP64 package (10mm x 10mm)**



**NOTE**

- Dimensions are expressed in millimeters.
- 尺寸仅做参考。

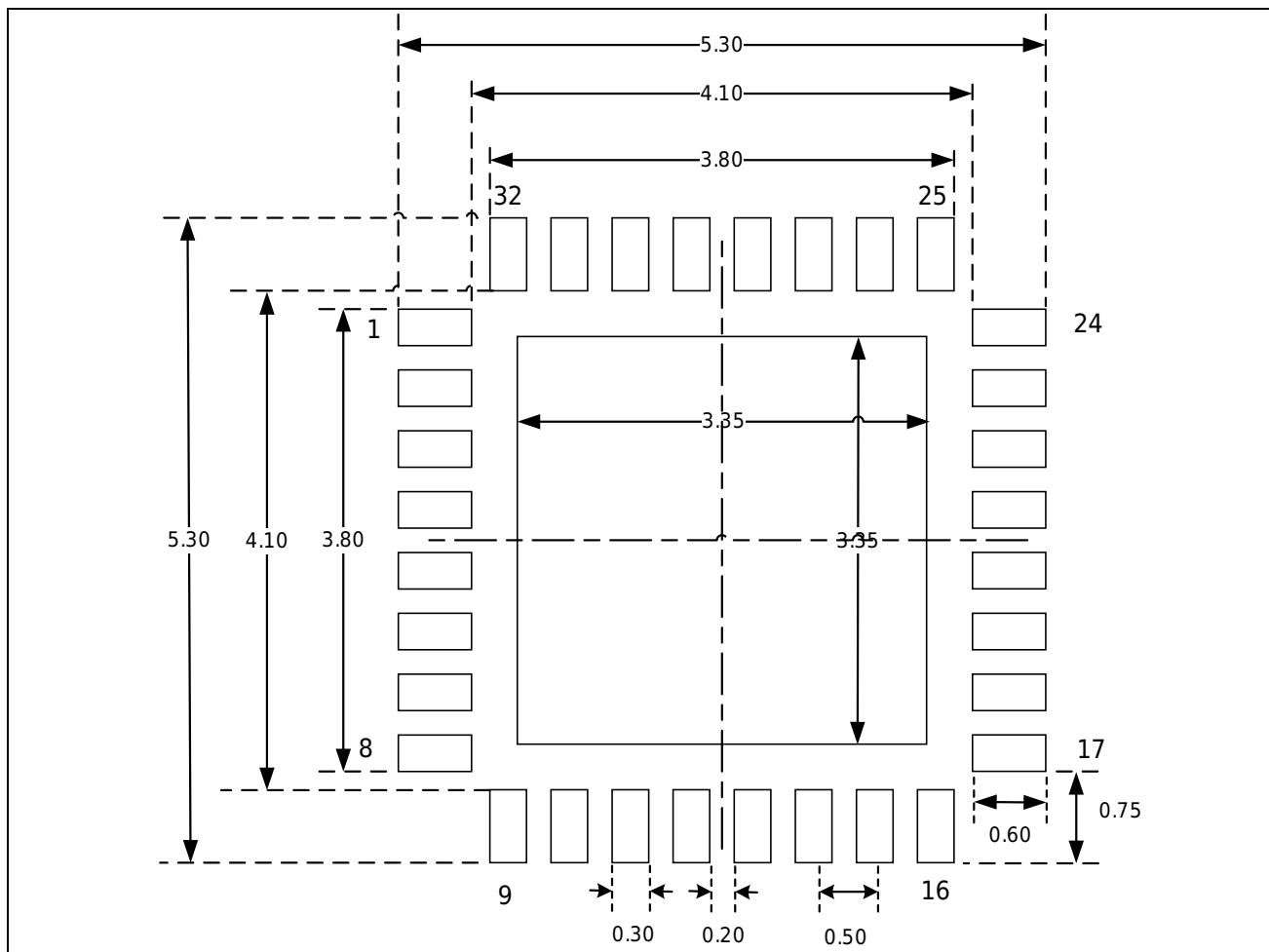
**LQFP48 package (7mm x 7mm)**



**NOTE**

- Dimensions are expressed in millimeters.
- 尺寸仅做参考。

## **QFN32 package (5mm x 5mm)**



## **NOTE**

- Dimensions are expressed in millimeters.
  - 尺寸仅做参考。

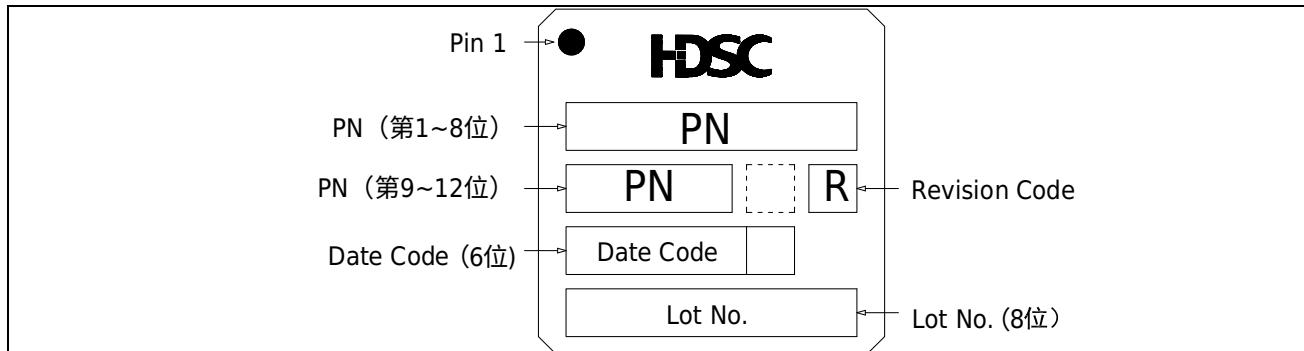
## 8.3 Marking Description

以下给出各封装正面丝印的 Pin 1 位置和信息说明。

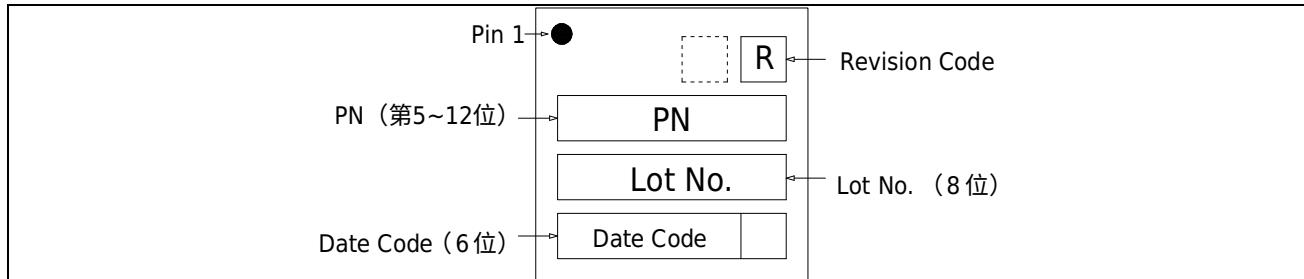
**LQFP100 package (14mm x 14mm)**

**LQFP64 package (10mm x 10mm)**

**LQFP48 package (7mm x 7mm)**



**QFN32 package (5mm x 5mm)**



**注意：**

- 上图空白框表示与生产相关的可选标记，本节不作说明。

## 8.4 Package Thermal Resistance

When the packaged chip works at a specified working environment temperature, the junction temperature  $T_j$  ( $^{\circ}\text{C}$ ) on the chip surface can be calculated according to the following formula:

$$T_j = T_{\text{amb}} + (P_D \times \theta_{JA})$$

- $T_{\text{amb}}$  refers to the working environment temperature when the packaged chip works, in  $^{\circ}\text{C}$ ;
- $\theta_{JA}$  refers to the thermal resistance coefficient of the package to the working environment, in  $^{\circ}\text{C}/\text{W}$ ;
- $P_D$  is equal to the sum of the chip's internal power consumption and I/O power consumption, in W. The chip's internal power consumption is the product's  $\text{IDD} \times \text{VDD}$ , and the I/O power consumption refers to the power consumption generated by the I/O pins when the chip is working. Usually, this part is very small and can be ignored.

When the chip works at a specified working environment temperature, the junction temperature  $T_j$  on the chip surface must not exceed the maximum allowable junction temperature  $T_J$  of the chip.

表 8-1 各封装热阻系数表

Package Type and Size	Thermal Resistance Junction-ambient Value ( $\theta_{JA}$ )	Unit
LQFP100 14mm x 14mm / 0.5mm pitch	50 +/- 10%	$^{\circ}\text{C}/\text{W}$
LQFP64 10mm x 10mm / 0.5mm pitch	65 +/- 10%	$^{\circ}\text{C}/\text{W}$
LQFP48 7mm x 7mm / 0.5mm pitch	75 +/- 10%	$^{\circ}\text{C}/\text{W}$
QFN32 5mm x 5mm / 0.5mm pitch	42 +/- 10%	$^{\circ}\text{C}/\text{W}$

## 9 Ordering Information

Part Number		HC32L072PATA-LQFP100	HC32L072KATA-LQFP64	HC32L072JATA-LQ48	HC32L072FAUA-QN32TR	HC32L073PATA-LQFP100	HC32L073KATA-LQFP64	HC32L073JATA-LQ48
Memory (bytes)	Flash	128K	128K	128K	128K	128K	128K	128K
	RAM	16K	16K	16K	16K	16K	16K	16K
I/O		86	50	36	22	86	52	38
TIMER	GTIMER	4	4	4	4	4	4	4
	ATIMER	3	3	3	3	3	3	3
	LPTIMER	2	2	2	2	2	2	2
	RTC	✓	✓	✓	✓	✓	✓	✓
	PCNT	1	1	1	1	1	1	1
Connectivity	UART	4	4	2	2	4	4	2
	LPUART	2	2	2	1	2	2	2
	I2C	2	2	2	1	2	2	2
	SPI	2	2	2	1	2	2	2
	USB	✓	✓	✓	✓	✓	-	-
	CAN	✓	✓	✓	✓	✓	✓	✓
	I2S	2	2	2	1	2	2	2
Analog	ADC*12bit	24ch	23ch	17ch	10ch	24ch	23ch	17ch
	DAC*12bit	2ch	2ch	2ch	2ch	2ch	2ch	2ch
	OP	5	5	3	1	5	5	3
	Comp	3	3	3	3	3	3	3
Display	LCD	-	-	-	-	4*52/6*50/8*48	4*40/6*38/8*36	4*26
Security	AES	✓	✓	✓	✓	✓	✓	✓
LVD		✓	✓	✓	✓	✓	✓	✓
LVR		✓	✓	✓	✓	✓	✓	✓
Votage	Vdd	1.8~5.5V	1.8~5.5V	1.8~5.5V	1.8~5.5V	1.8~5.5V	1.8~5.5V	1.8~5.5V
Package		LQFP100(14*14)	LQFP64(10*10)	LQFP48(7*7)	QFN32(5*5)	LQFP100(14*14)	LQFP64(10*10)	LQFP48(7*7)
Shipping form		Tray	Tray	Tray	Tape	Tray	Tray	Tray
Product thickness		1.6mm	1.6mm	1.6mm	0.75mm	1.6mm	1.6mm	1.6mm
Pad spacing		0.5mm	0.5mm	0.5mm	0.5mm	0.5mm	0.5mm	0.5mm

Before ordering, please contact the sales office for the latest mass production information.

## Version Revision History

Version	Date	Description
Rev1.00	2019/11/18	First draft published.
Rev1.10	2019/12/25	Updated the following information: ① Added QFN32 package; ② Typical application circuit diagram; ③ Illustrations and precautions for high-speed external clock XTH and low-speed external clock XTL; ④ Silkscreen description; ⑤ General working conditions description; ⑥ Ordering information.
Rev1.20	2020/04/10	Updated the following information: ① Pin function description; ② Added AVCC/3 accuracy in ADC characteristics; ③ 44/45/47/48pin changes for HC32L073KATA; ④ 32/33/35/36pin changes for HC32L073JATA.
Rev1.30	2020/05/29	Updated the following information: ① Corrected typos in 7.3.7.2; ② Added LCD controller; ③ RCL oscillator accuracy in 7.3.8.2; ④ Added low power timer description in Product Features.
Rev1.40	2020/06/30	Updated the following information: ① Added I2S information in the pin function description; ② Corrected LPTIM to LPTIMO, LPTIMx_ETR to LPTIMx_EXT; ③ Unified the pin function names.
Rev1.50	2020/07/31	Updated the following information: ① Added Sections 7.3.20, 7.3.21, 8.2, and 8.4; ② 7.3.11 Levels; ③ 7.3.13.2 Values of VIH and VIL.
Rev1.60	2020/09/30	Updated the following information: ① Functional block diagram; ② Added SPI features and I2S features (1); ③ 1.4 description; ④ 7.3.14 VIL and VIH; ⑤ Added 7.3.13.3; ⑥ The number of OPAs for HC32L072FAUA is 1.
Rev1.70	2021/05/31	Updated the following information: ① Modified the statement; ② Corrected the ANALOG function of PB04 in the pin function description; ③ tHD STA and tSU STO parameters in the I2C characteristics; ④ Data retention period in the memory characteristics; ⑤ Added the gm parameter in the external clock source characteristics.
Rev1.80	2022/03/09	Company Logo updated.
Rev1.81	2022/08/13	Updated the following information: ① 3.2 Pin function description, deleted the PF01 function mapping of TIM4_CHB; ② 7.3.14 RESETB pin characteristics, input filter pulse time modification.
Rev1.82	2023/06/21	Updated the following information: ① The APB1 address range error in the storage area mapping diagram was modified.
Rev1.83	2024/06/25	Updated the following information: ① Modified the number of ADC and VC channels in 1.29 and 1.31, deleted the 1.2V related description, and deleted the 1.2V related description in 7.3.16; ② Modified the storage temperature range in Table 7-3 Temperature Characteristics; ③ Added the "7.3.8.3 Internal Low-Speed Clock 10k Oscillator" section.
Rev1.84	2024/12/12	Updated the following information: ① Updated the contents of chapters "7.3.7.3 High-speed external clock XTH" and "7.3.7.4 Low-speed external clock XTL".
Rev1.85	2025/03/28	Updated the following information: ① Updated the relevant parameters in Table 7-16 SPI interface characteristics; ② Modified the maximum value of the input filtered pulse and the minimum value of the input non-filtered pulse in 7.3.14 RESETB pin characteristics.