CY8C21123, CY8C21223, CY8C21323
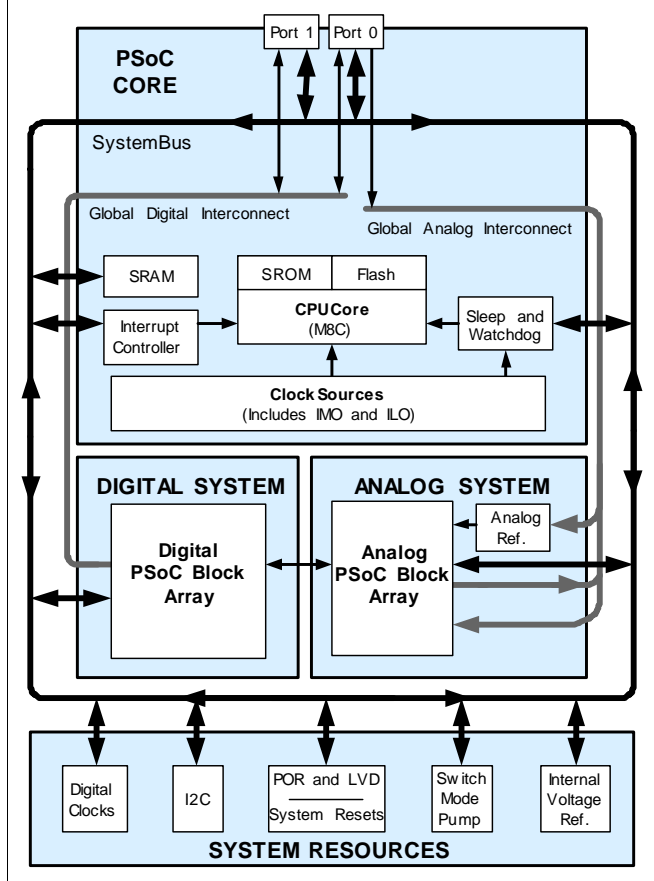
PSoC® Programmable System-on-Chip™

Features

- Powerful Harvard Architecture Processor:
  - M8C Processor Speeds to 24 MHz
  - Low Power at High Speed
  - 2.4V to 5.25V Operating Voltage
  - Operating Voltages down to 1.0V using On-Chip Switch Mode Pump (SMP)
  - Industrial Temperature Range: -40°C to +85°C

- Advanced Peripherals (PSoC® Blocks):
  - Four Analog Type "E" PSoC Blocks Provide:
    - Two Comparators with DAC Refs
    - Single or Dual 8-Bit 8:1 ADC
  - Four Digital PSoC Blocks Provide:
    - 8 to 32-Bit Timers, Counters, and PWMs
    - CRC and PRS Modules
  - Full Duplex UART, SPI™ Master or Slave: Connectable to All GPIO Pins
  - Complex Peripherals by Combining Blocks

- Flexible On-Chip Memory:
  - 4K Flash Program Storage 50,000 Erase/Write Cycles
  - 256 Bytes SRAM Data Storage
  - In-System Serial Programming (ISSP)
  - Partial Flash Updates
  - Flexible Protection Modes
  - EEPROM Emulation in Flash

- Complete Development Tools:
  - Free Development Software (PSoC Designer™)
  - Full Featured, In-Circuit Emulator and Programmer
  - Full Speed Emulation
  - Complex Breakpoint Structure
  - 128 Bytes Trace Memory

- Precision, Programmable Clocking:
  - Internal ±2.5% 24/48 MHz Oscillator
  - Internal Oscillator for Watchdog and Sleep

- Programmable Pin Configurations:
  - 25 mA Sink, 10 mA Drive on All GPIO
  - Pull Up, Pull Down, High Z, Strong, or Open Drain Drive Modes on All GPIO
  - Up to Eight Analog Inputs on GPIO
  - Configurable Interrupt on all GPIO

- Additional System Resources:
  - I²C™ Master, Slave and MultiMaster to 400 kHz
  - Watchdog and Sleep Timers
  - User Configurable Low Voltage Detection
  - Integrated Supervisory Circuit
  - On-Chip Precision Voltage Reference

Logic Block Diagram

PSoC Functional Overview

The PSoC family consists of many programmable system-on-chip controller devices. These devices are designed to replace multiple traditional MCU-based system components with a low cost single-chip programmable component. A PSoC device includes configurable blocks of analog and digital logic, and programmable interconnect. This architecture allows the user to create customized peripheral configurations, to match the requirements of each individual application. Additionally, a fast CPU, Flash program memory, SRAM data memory, and configurable IO are included in a range of convenient pinouts.

The PSoC architecture, as shown in Figure 1, consists of four main areas: the Core, the System Resources, the Digital System, and the Analog System. Configurable global bus resources allow the combining of all device resources into a complete custom system. Each PSoC device includes four digital blocks. Depending on the PSoC package, up to two analog comparators and up to 16 General Purpose IO (GPIO) are also included. The GPIO provide access to the global digital and analog interconnects.

PSoC Core

The PSoC Core is a powerful engine that supports a rich instruction set. It encompasses SRAM for data storage, an interrupt controller, sleep and watchdog timers, and IMO (internal main oscillator) and ILO (internal low speed oscillator). The CPU core, called the M8C, is a powerful processor with speeds up to 24 MHz. The M8C is a four MIPS 8-bit Harvard architecture microprocessor.

System Resources provide additional capability, such as digital clocks to increase the flexibility of the PSoC Programmable System-on-Chips, I2C functionality for implementing an I2C master, slave, MultiMaster, an internal voltage reference that provides an absolute value of 1.3V to a number of PSoC subsystems, a switch mode pump (SMP) that generates normal operating voltages off a single battery cell, and various system resets supported by the M8C.

The Digital System consists of an array of digital PSoC blocks, which can be configured into any number of digital peripherals. The digital blocks can be connected to the GPIO through a series of global bus that can route any signal to any pin. This frees designs from the constraints of a fixed peripheral controller.

The Analog System consists of four analog PSoC blocks, supporting comparators and analog-to-digital conversion up to 8 bits in precision.

Digital System

The Digital System consists of four digital PSoC blocks. Each block is an 8-bit resource that can be used alone or combined with other blocks to form 8, 16, 24, and 32-bit peripherals, which are called user module references. Digital peripheral configurations include:

■ PWMs (8 to 32 bit)

■ PWMs with Dead band (8 to 32 bit)

■ Counters (8 to 32 bit)

■ Timers (8 to 32 bit)

■ UART 8 bit with selectable parity (up to four)

■ SPI master and slave

■ I2C slave, master, MultiMaster (one available as a System Resource)

■ Cyclical Redundancy Checker/Generator (8 to 32 bit)

■ IrDA (up to four)

■ Pseudo Random Sequence Generators (8 to 32 bit)

The digital blocks can be connected to any GPIO through a series of global bus that can route any signal to any pin. The busses also allow for signal multiplexing and performing logic operations. This configurability frees your designs from the constraints of a fixed peripheral controller.

Digital blocks are provided in rows of four, where the number of blocks varies by PSoC device family. This provides an optimum choice of system resources for your application. Family resources are shown in Table 1 on page 3.

**Figure 1. Digital System Block Diagram**
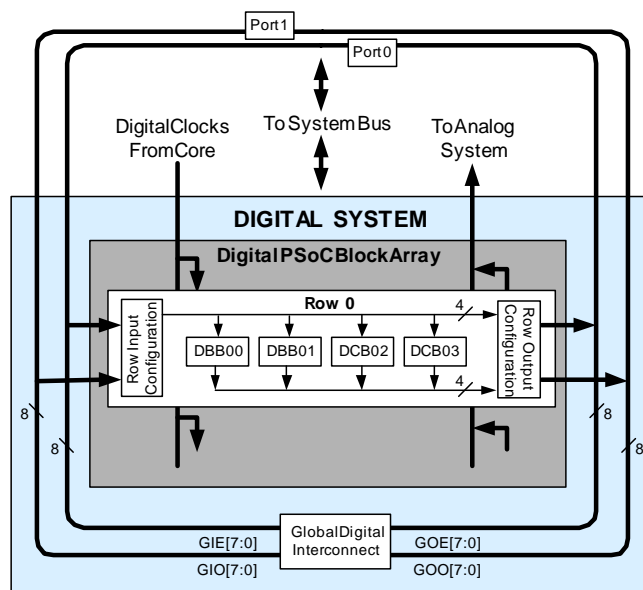
Analog System

The Analog System consists of four configurable blocks to allow creation of complex analog signal flows. Analog peripherals are very flexible and may be customized to support specific application requirements. Some of the more common PSoC analog functions (most available as user modules) are:

■ Analog-to-digital converters (single or dual, with 8-bit or 10-bit resolution)

■ Pin-to-pin comparators (one)

■ Single-ended comparators (up to 2) with absolute (1.3V) reference or 8-bit DAC reference

■ 1.3V reference (as a System Resource)

In most PSoC devices, analog blocks are provided in columns of three, which includes one CT (Continuous Time) and two SC (Switched Capacitor) blocks. The CY8C21x23 devices provide limited functionality Type "E" analog blocks. Each column contains one CT block and one SC block.

The number of blocks on the device family is listed in Table 1.

Figure 2. CY8C21x23 Analog System Block Diagram
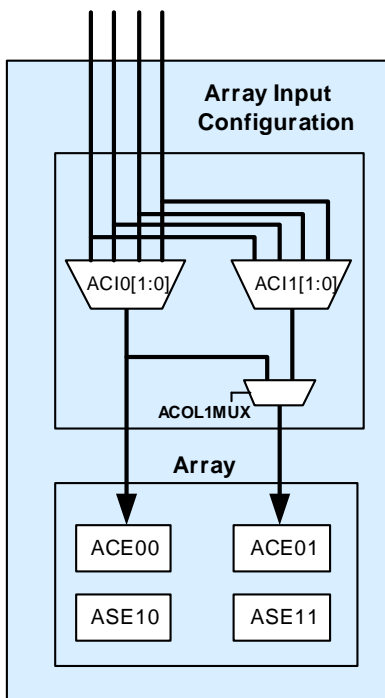
Additional System Resources

System Resources, some of which listed in the previous sections, provide additional capability useful to complete systems. Additional resources include a switch mode pump, low voltage detection, and power on reset. The merits of each system resource are.

■ Digital clock dividers provide three customizable clock frequencies for use in applications. The clocks can be routed to both the digital and analog systems. Additional clocks can be generated using digital PSoC blocks as clock dividers.

■ The I2C module provides 100 and 400 kHz communication over two wires. Slave, master, and multi-master modes are all supported.

■ Low Voltage Detection (LVD) interrupts can signal the application of falling voltage levels, while the advanced POR (Power On Reset) circuit eliminates the need for a system supervisor.

■ An internal 1.3 voltage reference provides an absolute reference for the analog system, including ADCs and DACs.

■ An integrated switch mode pump (SMP) generates normal operating voltages from a single 1.2V battery cell, providing a low cost boost converter.

PSoC Device Characteristics

Depending on your PSoC device characteristics, the digital and analog systems can have 16, 8, or 4 digital blocks, and 12, 6, or 4 analog blocks. Table 1 lists the resources available for specific PSoC device groups. The PSoC device covered by this data sheet is highlighted.

Table 1. PSoC Device Characteristics

PSoC Part Number	Digital IO	Digital Rows	Digital Blocks	Analog Inputs	Analog Outputs	Analog Columns	Analog Blocks	SRAM Size	Flash
CY8C29x66	up to 64	4	16	12	4	4	12	2K	32 K
CY8C27x43	up to 44	2	8	12	4	4	12	256 Bytes	16 K
CY8C24x94	56	1	4	48	2	2	6	1K	16 K
CY8C24x23A	up to 24	1	4	12	2	2	6	256 Bytes	4K
CY8C21x34	up to 28	1	4	28	0	2	4[1]	512 Bytes	8K
CY8C21x23	**16**	**1**	**4**	**8**	**0**	**2**	**4[1]**	**256 Bytes**	**4K**
CY8C20x34	up to 28	0	0	28	0	0	3[2]	512 Bytes	8K

.

Notes
1. Limited analog functionality
2. Two analog blocks and one CapSense™

[+] Feedback

Getting Started

The quickest way to understand PSoC silicon is to read this data sheet and then use the PSoC Designer Integrated Development Environment (IDE). This data sheet is an overview of the PSoC integrated circuit and presents specific pin, register, and electrical specifications.

For in depth information, along with detailed programming details, see the PSoC® Programmable System-on-Chip™ Technical Reference Manual for CY8C28xxx PSoC devices.

For up to date ordering, packaging, and electrical specification information, see the latest PSoC device data sheets on the web at www.cypress.com/psoc.

Application Notes

Application notes are an excellent introduction to the wide variety of possible PSoC designs. They are located here: www.cypress.com/psoc. Select Application Notes under the Documentation tab.

Development Kits

PSoC Development Kits are available online from Cypress at www.cypress.com/shop and through a growing number of regional and global distributors, which include Arrow, Avnet, Digi-Key, Farnell, Future Electronics, and Newark.

Training

Free PSoC technical training (on demand, webinars, and workshops) is available online at www.cypress.com/training. The training covers a wide variety of topics and skill levels to assist you in your designs.

CYPros Consultants

Certified PSoC Consultants offer everything from technical assistance to completed PSoC designs. To contact or become a PSoC Consultant go to www.cypress.com/cypros.

Solutions Library

Visit our growing library of solution focused designs at www.cypress.com/solutions. Here you can find various application designs that include firmware and hardware design files that enable you to complete your designs quickly.

Technical Support

For assistance with technical issues, search KnowledgeBase articles and forums at www.cypress.com/support. If you cannot find an answer to your question, call technical support at 1-800-541-4736.

Development Tools

PSoC Designer is a Microsoft® Windows-based, integrated development environment for the Programmable System-on-Chip (PSoC) devices. The PSoC Designer IDE runs on Windows XP or Windows Vista.

This system provides design database management by project, an integrated debugger with In-Circuit Emulator, in-system programming support, and built in support for third party assemblers and C compilers.

PSoC Designer also supports C language compilers developed specifically for the devices in the PSoC family.

PSoC Designer Software Subsystems

System-Level View

A drag-and-drop visual embedded system design environment based on PSoC Express. In the system level view you create a model of your system inputs, outputs, and communication interfaces. You define when and how an output device changes state based upon any or all other system devices. Based upon the design, PSoC Designer automatically selects one or more PSoC Programmable System-on-Chip Controllers that match your system requirements.

PSoC Designer generates all embedded code, then compiles and links it into a programming file for a specific PSoC device.

Chip-Level View

The chip-level view is a more traditional integrated development environment (IDE) based on PSoC Designer 4.4. Choose a base device to work with and then select different onboard analog and digital components called user modules that use the PSoC blocks. Examples of user modules are ADCs, DACs, Amplifiers, and Filters. Configure the user modules for your chosen application and connect them to each other and to the proper pins. Then generate your project. This prepopulates your project with APIs and libraries that you can use to program your application.

The device editor also supports easy development of multiple configurations and dynamic reconfiguration. Dynamic configuration allows for changing configurations at run time.

Hybrid Designs

You can begin in the system-level view, allow it to choose and configure your user modules, routing, and generate code, then switch to the chip-level view to gain complete control over on-chip resources. All views of the project share a common code editor, builder, and common debug, emulation, and programming tools.

[+] Feedback

Code Generation Tools

PSoC Designer supports multiple third party C compilers and assemblers. The code generation tools work seamlessly within the PSoC Designer interface and have been tested with a full range of debugging tools. The choice is yours.

Assemblers. The assemblers allow assembly code to merge seamlessly with C code. Link libraries automatically use absolute addressing or are compiled in relative mode, and linked with other software modules to get absolute addressing.

C Language Compilers. C language compilers are available that support the PSoC family of devices. The products allow you to create complete C programs for the PSoC family devices.

The optimizing C compilers provide all the features of C tailored to the PSoC architecture. They come complete with embedded libraries providing port and bus operations, standard keypad and display support, and extended math functionality.

Debugger

The PSoC Designer Debugger subsystem provides hardware in-circuit emulation, allowing you to test the program in a physical system while providing an internal view of the PSoC device. Debugger commands allow the designer to read and program and read and write data memory, read and write IO registers, read and write CPU registers, set and clear breakpoints, and provide program run, halt, and step control. The debugger also allows the designer to create a trace buffer of registers and memory locations of interest.

Online Help System

The online help system displays online, context-sensitive help for the user. Designed for procedural and quick reference, each functional subsystem has its own context-sensitive help. This system also provides tutorials and links to FAQs and an Online Support Forum to aid the designer in getting started.

In-Circuit Emulator

A low cost, high functionality In-Circuit Emulator (ICE) is available for development support. This hardware has the capability to program single devices.

The emulator consists of a base unit that connects to the PC by way of a USB port. The base unit is universal and operates with all PSoC devices. Emulation pods for each device family are available separately. The emulation pod takes the place of the PSoC device in the target board and performs full speed (24 MHz) operation.

Designing with PSoC Designer

The development process for the PSoC device differs from that of a traditional fixed function microprocessor. The configurable analog and digital hardware blocks give the PSoC architecture a unique flexibility that pays dividends in managing specification change during development and by lowering inventory costs. These configurable resources, called PSoC Blocks, have the ability to implement a wide variety of user selectable functions.

The PSoC development process can be summarized in the following four steps:

1. Select Components
2. Configure Components
3. Organize and Connect
4. Generate, Verify, and Debug

Select Components

Both the system-level and chip-level views provide a library of prebuilt, pretested hardware peripheral components. In the system-level view, these components are called "drivers" and correspond to inputs (a thermistor, for example), outputs (a brushless DC fan, for example), communication interfaces (I^2C-bus, for example), and the logic to control how they interact with one another (called valuators).

In the chip-level view, the components are called "user modules". User modules make selecting and implementing peripheral devices simple, and come in analog, digital, and programmable system-on-chip varieties.

Configure Components

Each of the components you select establishes the basic register settings that implement the selected function. They also provide parameters and properties that allow you to tailor their precise configuration to your particular application. For example, a Pulse Width Modulator (PWM) User Module configures one or more digital PSoC blocks, one for each 8 bits of resolution. The user module parameters permit you to establish the pulse width and duty cycle. Configure the parameters and properties to correspond to your chosen application. Enter values directly or by selecting values from drop-down menus.

Both the system-level drivers and chip-level user modules are documented in data sheets that are viewed directly in the PSoC Designer. These data sheets explain the internal operation of the component and provide performance specifications. Each data sheet describes the use of each user module parameter or driver property, and other information you may need to successfully implement your design.

Organize and Connect

You can build signal chains at the chip level by interconnecting user modules to each other and the IO pins, or connect system level inputs, outputs, and communication interfaces to each other with valuator functions.

In the system-level view, selecting a potentiometer driver to control a variable speed fan driver and setting up the valuators to control the fan speed based on input from the pot selects, places, routes, and configures a programmable gain amplifier (PGA) to buffer the input from the potentiometer, an analog to digital converter (ADC) to convert the potentiometer's output to a digital signal, and a PWM to control the fan.

In the chip-level view, perform the selection, configuration, and routing so that you have complete control over the use of all on-chip resources.

Generate, Verify, and Debug

When you are ready to test the hardware configuration or move on to developing code for the project, perform the "Generate Application" step. This causes PSoC Designer to generate source code that automatically configures the device to your specification and provides the software for the system.

Both system-level and chip-level designs generate software based on your design. The chip-level design provides application programming interfaces (APIs) with high level functions to control and respond to hardware events at run time and interrupt service routines that you can adapt as needed. The system-level design also generates a C `main()` program that completely controls the chosen application and contains placeholders for custom code at strategic positions allowing you to further refine the software without disrupting the generated code.

A complete code development environment allows you to develop and customize your applications in C, assembly language, or both.

The last step in the development process takes place inside the PSoC Designer's Debugger subsystem. The Debugger downloads the HEX image to the ICE where it runs at full speed. Debugger capabilities rival those of systems costing many times more. In addition to traditional single-step, run-to-breakpoint and watch-variable features, the Debugger provides a large trace buffer and allows you define complex breakpoint events that include monitoring address and data bus values, memory locations and external signals.

Document Conventions

Acronyms Used

This table lists the acronyms used in this data sheet.

Table 2. Acronyms

Acronym	Description
AC	alternating current
ADC	analog-to-digital converter
API	application programming interface
CPU	central processing unit
CT	continuous time
DAC	digital-to-analog converter
DC	direct current
EEPROM	electrically erasable programmable read-only memory
FSR	full scale range
GPIO	general purpose IO
ICE	in-circuit emulator
IDE	integrated development environment
IO	input/output
ISSP	in-system serial programming
IPOR	imprecise power on reset
LSb	least-significant bit
LVD	low voltage detect
MSb	most-significant bit
PC	program counter
PGA	programmable gain amplifier
POR	power on reset
PPOR	precision power on reset
PSoC®	Programmable System-on-Chip™
PWM	pulse width modulator
ROM	read only memory
SC	switched capacitor
SMP	switch mode pump
SRAM	static random access memory

Units of Measure

A units of measure table is located in the section Electrical Specifications on page 15. Table 11 on page 15 lists all the abbreviations used to measure the PSoC devices.

Numeric Naming

Hexadecimal numbers are represented with all letters in uppercase with an appended lowercase 'h' (for example, '14h' or '3Ah'). Hexadecimal numbers may also be represented by a '0x' prefix, the C coding convention. Binary numbers have an appended lowercase 'b' (for example, 01010100b' or '01000011b'). Numbers not indicated by an 'h', 'b', or 0x are decimal.

Pin Information

This section describes, lists, and illustrates the CY8C21x23 PSoC device pins and pinout configurations. Every port pin (labeled with a "P") is capable of Digital IO. However, Vss, Vdd, SMP, and XRES are not capable of Digital IO.
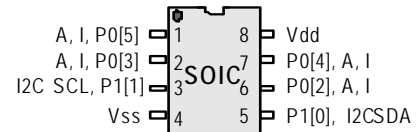
8-Pin Part Pinout

Table 3. Pin Definitions - CY8C21123 8-Pin SOIC

Pin No.	Type		Pin Name	Description
	Digital	Analog		
1	IO	I	P0[5]	Analog Column Mux Input
2	IO	I	P0[3]	Analog Column Mux Input
3	IO		P1[1]	I2C Serial Clock (SCL), ISSP-SCLK[3]
4	Power		Vss	Ground Connection
5	IO		P1[0]	I2C Serial Data (SDA), ISSP-SDATA[3]
6	IO	I	P0[2]	Analog Column Mux Input
7	IO	I	P0[4]	Analog Column Mux Input
8	Power		Vdd	Supply Voltage

LEGEND: A = Analog, I = Input, and O = Output.
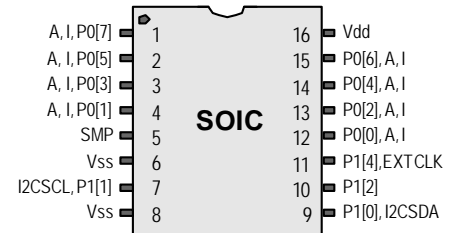
Figure 3. CY8C21123 8-Pin SOIC

16-Pin Part Pinout

Table 4. Pin Definitions - CY8C21223 16-Pin SOIC

Pin No.	Type		Pin Name	Description
	Digital	Analog		
1	IO	I	P0[7]	Analog Column Mux Input
2	IO	I	P0[5]	Analog Column Mux Input
3	IO	I	P0[3]	Analog Column Mux Input
4	IO	I	P0[1]	Analog Column Mux Input
5	Power		SMP	Switch Mode Pump (SMP) Connection to required External Components
6	Power		Vss	Ground Connection
7	IO		P1[1]	I2C Serial Clock (SCL), ISSP-SCLK[3]
8	Power		Vss	Ground Connection
9	IO		P1[0]	I2C Serial Data (SDA), ISSP-SDATA[3]
10	IO		P1[2]	
11	IO		P1[4]	Optional External Clock Input (EXTCLK)
12	IO	I	P0[0]	Analog Column Mux Input
13	IO	I	P0[2]	Analog Column Mux Input
14	IO	I	P0[4]	Analog Column Mux Input
15	IO	I	P0[6]	Analog Column Mux Input
16	Power		Vdd	Supply Voltage

LEGEND A = Analog, I = Input, and O = Output.

Figure 4. CY8C21223 16-Pin SOIC

[+] Feedback

Table 5. Pin Definitions - CY8C21223 16-Pin COL [3]

Pin No.	Type		Pin Name	Description
	Digital	**Analog**		
1	IO	I	P0[3]	Analog Column Mux Input
2	IO	I	P0[1]	Analog Column Mux Input
3	IO		P1[7]	I2C Serial Clock (SCL)
4	IO		P1[5]	I2C Serial Data (SDA)
5	IO		P1[3]	
6	IO		P1[1]	I2C Serial Clock (SCL), ISSP-SCLK[3]
7	Power		Vss	Ground Connection
8	IO		P1[0]	I2C Serial Data (SDA), ISSP-SDATA[3]
9	IO		P1[6]	
10	IO		P1[4]	EXTCLK
11	Input		XRES	Active High External Reset with Internal Pull Down
12	IO	I	P0[4]	V_{REF}
13	Power		Vdd	Supply Voltage
14	IO	I	P0[7]	Analog Column Mux Input
15	IO	I	P0[5]	Analog Column Mux Input
16			NC	No Connect

LEGEND A = Analog, I = Input, and O = Output.
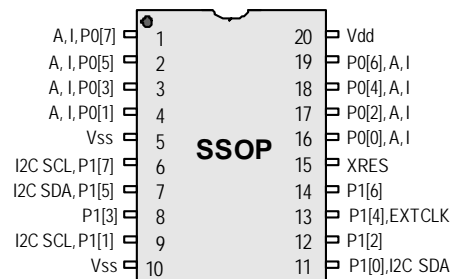
Figure 5. CY8C21223 16-Pin COL

20-Pin Part Pinout

Table 6. Pin Definitions - CY8C21323 20-Pin SSOP

Pin No.	Type		Pin Name	Description
	Digital	**Analog**		
1	IO	I	P0[7]	Analog Column Mux Input
2	IO	I	P0[5]	Analog Column Mux Input
3	IO	I	P0[3]	Analog Column Mux Input
4	IO	I	P0[1]	Analog Column Mux Input
5	Power		Vss	Ground Connection
6	IO		P1[7]	I2C Serial Clock (SCL)
7	IO		P1[5]	I2C Serial Data (SDA)
8	IO		P1[3]	
9	IO		P1[1]	I2C Serial Clock (SCL), ISSP-SCLK[3]
10	Power		Vss	Ground connection
11	IO		P1[0]	I2C Serial Data (SDA), ISSP-SDATA[3]
12	IO		P1[2]	
13	IO		P1[4]	Optional External Clock Input (EXTCLK)
14	IO		P1[6]	
15	Input		XRES	Active High External Reset with Internal Pull Down
16	IO	I	P0[0]	Analog Column Mux Input
17	IO	I	P0[2]	Analog Column Mux Input
18	IO	I	P0[4]	Analog Column Mux Input
19	IO	I	P0[6]	Analog Column Mux Input
20	Power		Vdd	Supply Voltage

LEGEND A = Analog, I = Input, and O = Output.

Figure 6. CY8C21323 20-Pin SSOP

[+] Feedback

24-Pin Part Pinout

Table 7. Pin Definitions - CY8C21323 24-Pin QFN[5]

Pin No.	Type		Pin Name	Description
	Digital	**Analog**		
1	IO	I	P0[1]	Analog Column Mux Input
2	Power		SMP	Switch Mode Pump (SMP) Connection to required External Components
3	Power		Vss	Ground connection
4	IO		P1[7]	I2C Serial Clock (SCL)
5	IO		P1[5]	I2C Serial Data (SDA)
6	IO		P1[3]	
7	IO		P1[1]	I2C Serial Clock (SCL), ISSP-SCLK[3]
8			NC	No Connection
9	Power		Vss	Ground Connection
10	IO		P1[0]	I2C Serial Data (SDA), ISSP-SDATA[3]
11	IO		P1[2]	
12	IO		P1[4]	Optional External Clock Input (EXTCLK)
13	IO		P1[6]	
14	Input		XRES	Active High External Reset with Internal Pull Down
15			NC	No Connection
16	IO	I	P0[0]	Analog Column Mux Input
17	IO	I	P0[2]	Analog Column Mux Input
18	IO	I	P0[4]	Analog Column Mux Input
19	IO	I	P0[6]	Analog Column Mux Input
20	Power		Vdd	Supply Voltage
21	Power		Vss	Ground Connection
22	IO	I	P0[7]	Analog Column Mux Input
23	IO	I	P0[5]	Analog Column Mux Input
24	IO	I	P0[3]	Analog Column Mux Input

LEGEND A = Analog, I = Input, and O = Output.

Figure 7. CY8C21323 24-Pin QFN
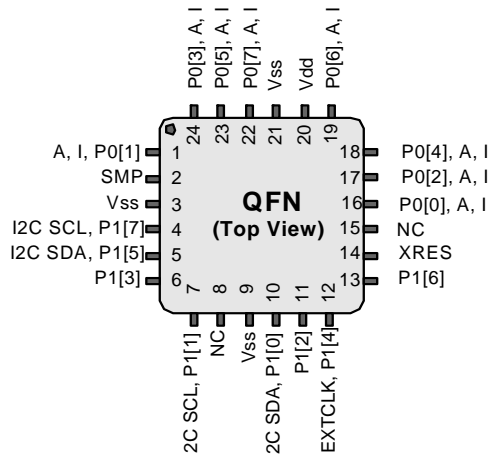
Note
5. The center pad on the QFN package must be connected to ground (Vss) for best mechanical, thermal, and electrical performance. If not connected to ground, it must be electrically floated and not connected to any other signal.

[+] Feedback

Register Reference

This section lists the registers of the CY8C21x23 PSoC device. For detailed register information, refer the PSoC Programmable System-on-Chip Technical Reference Manual.

Register Conventions

The register conventions specific to this section are listed in the following table.

Table 8. Register Conventions

Convention	Description
R	Read register or bit(s)
W	Write register or bit(s)
L	Logical register or bit(s)
C	Clearable register or bit(s)
#	Access is bit specific

Register Mapping Tables

The PSoC device has a total register address space of 512 bytes. The register space is referred to as IO space and is divided into two banks. The XOI bit in the Flag register (CPU_F) determines which bank the user is currently in. When the XOI bit is set the user is in Bank 1.

Note In the following register mapping tables, blank fields are Reserved and must not be accessed.

CY8C21123, CY8C21223, CY8C21323

Table 9. Register Map Bank 0 Table: User Space

Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access
PRT0DR	00	RW		40		ASE10CR0	80	RW		C0	
PRT0IE	01	RW		41			81			C1	
PRT0GS	02	RW		42			82			C2	
PRT0DM2	03	RW		43			83			C3	
PRT1DR	04	RW		44		ASE11CR0	84	RW		C4	
PRT1IE	05	RW		45			85			C5	
PRT1GS	06	RW		46			86			C6	
PRT1DM2	07	RW		47			87			C7	
	08			48			88			C8	
	09			49			89			C9	
	0A			4A			8A			CA	
	0B			4B			8B			CB	
	0C			4C			8C			CC	
	0D			4D			8D			CD	
	0E			4E			8E			CE	
	0F			4F			8F			CF	
	10			50			90			D0	
	11			51			91			D1	
	12			52			92			D2	
	13			53			93			D3	
	14			54			94			D4	
	15			55			95			D5	
	16			56			96		I2C_CFG	D6	RW
	17			57			97		I2C_SCR	D7	#
	18			58			98		I2C_DR	D8	RW
	19			59			99		I2C_MSCR	D9	#
	1A			5A			9A		INT_CLR0	DA	RW
	1B			5B			9B		INT_CLR1	DB	RW
	1C			5C			9C			DC	
	1D			5D			9D		INT_CLR3	DD	RW
	1E			5E			9E		INT_MSK3	DE	RW
	1F			5F			9F			DF	
DBB00DR0	20	#	AMX_IN	60	RW		A0		INT_MSK0	E0	RW
DBB00DR1	21	W		61			A1		INT_MSK1	E1	RW
DBB00DR2	22	RW	PWM_CR	62	RW		A2		INT_VC	E2	RC
DBB00CR0	23	#		63			A3		RES_WDT	E3	W
DBB01DR0	24	#	CMP_CR0	64	#		A4			E4	
DBB01DR1	25	W		65			A5			E5	
DBB01DR2	26	RW	CMP_CR1	66	RW		A6		DEC_CR0	E6	RW
DBB01CR0	27	#		67			A7		DEC_CR1	E7	RW
DCB02DR0	28	#	ADC0_CR	68	#		A8			E8	
DCB02DR1	29	W	ADC1_CR	69	#		A9			E9	
DCB02DR2	2A	RW		6A			AA			EA	
DCB02CR0	2B	#		6B			AB			EB	
DCB03DR0	2C	#	TMP_DR0	6C	RW		AC			EC	
DCB03DR1	2D	W	TMP_DR1	6D	RW		AD			ED	
DCB03DR2	2E	RW	TMP_DR2	6E	RW		AE			EE	
DCB03CR0	2F	#	TMP_DR3	6F	RW		AF			EF	

Blank fields are Reserved and must not be accessed.   # Access is bit specific.

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Table 9. Register Map Bank 0 Table: User Space (continued)

Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access
	30			70		RDI0RI	B0	RW		F0	
	31			71		RDI0SYN	B1	RW		F1	
	32		ACE00CR1	72	RW	RDI0IS	B2	RW		F2	
	33		ACE00CR2	73	RW	RDI0LT0	B3	RW		F3	
	34			74		RDI0LT1	B4	RW		F4	
	35			75		RDI0RO0	B5	RW		F5	
	36		ACE01CR1	76	RW	RDI0RO1	B6	RW		F6	
	37		ACE01CR2	77	RW		B7		CPU_F	F7	RL
	38			78			B8			F8	
	39			79			B9			F9	
	3A			7A			BA			FA	
	3B			7B			BB			FB	
	3C			7C			BC			FC	
	3D			7D			BD			FD	
	3E			7E			BE		CPU_SCR1	FE	#
	3F			7F			BF		CPU_SCR0	FF	#

Blank fields are Reserved and must not be accessed.   # Access is bit specific.

Table 10. Register Map Bank 1 Table: Configuration Space

Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access
PRT0DM0	00	RW		40		ASE10CR0	80	RW		C0	
PRT0DM1	01	RW		41			81			C1	
PRT0IC0	02	RW		42			82			C2	
PRT0IC1	03	RW		43			83			C3	
PRT1DM0	04	RW		44		ASE11CR0	84	RW		C4	
PRT1DM1	05	RW		45			85			C5	
PRT1IC0	06	RW		46			86			C6	
PRT1IC1	07	RW		47			87			C7	
	08			48			88			C8	
	09			49			89			C9	
	0A			4A			8A			CA	
	0B			4B			8B			CB	
	0C			4C			8C			CC	
	0D			4D			8D			CD	
	0E			4E			8E			CE	
	0F			4F			8F			CF	
	10			50			90		GDI_O_IN	D0	RW
	11			51			91		GDI_E_IN	D1	RW
	12			52			92		GDI_O_OU	D2	RW
	13			53			93		GDI_E_OU	D3	RW
	14			54			94			D4	
	15			55			95			D5	
	16			56			96			D6	
	17			57			97			D7	
	18			58			98			D8	
	19			59			99			D9	
	1A			5A			9A			DA	
	1B			5B			9B			DB	

Blank fields are Reserved and must not be accessed.   # Access is bit specific.

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Table 10. Register Map Bank 1 Table: Configuration Space (continued)

Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access
	1C			5C			9C			DC	
	1D			5D			9D		OSC_GO_EN	DD	RW
	1E			5E			9E		OSC_CR4	DE	RW
	1F			5F			9F		OSC_CR3	DF	RW
DBB00FN	20	RW	CLK_CR0	60	RW		A0		OSC_CR0	E0	RW
DBB00IN	21	RW	CLK_CR1	61	RW		A1		OSC_CR1	E1	RW
DBB00OU	22	RW	ABF_CR0	62	RW		A2		OSC_CR2	E2	RW
	23		AMD_CR0	63	RW		A3		VLT_CR	E3	RW
DBB01FN	24	RW	CMP_GO_EN	64	RW		A4		VLT_CMP	E4	R
DBB01IN	25	RW		65			A5		ADC0_TR	E5	RW
DBB01OU	26	RW	AMD_CR1	66	RW		A6		ADC1_TR	E6	RW
	27		ALT_CR0	67	RW		A7			E7	
DCB02FN	28	RW		68			A8		IMO_TR	E8	W
DCB02IN	29	RW		69			A9		ILO_TR	E9	W
DCB02OU	2A	RW		6A			AA		BDG_TR	EA	RW
	2B		CLK_CR3	6B	RW		AB		ECO_TR	EB	W
DCB03FN	2C	RW	TMP_DR0	6C	RW		AC			EC	
DCB03IN	2D	RW	TMP_DR1	6D	RW		AD			ED	
DCB03OU	2E	RW	TMP_DR2	6E	RW		AE			EE	
	2F		TMP_DR3	6F	RW		AF			EF	
	30			70		RDI0RI	B0	RW		F0	
	31			71		RDI0SYN	B1	RW		F1	
	32		ACE00CR1	72	RW	RDI0IS	B2	RW		F2	
	33		ACE00CR2	73	RW	RDI0LT0	B3	RW		F3	
	34			74		RDI0LT1	B4	RW		F4	
	35			75		RDI0RO0	B5	RW		F5	
	36		ACE01CR1	76	RW	RDI0RO1	B6	RW		F6	
	37		ACE01CR2	77	RW		B7		CPU_F	F7	RL
	38			78			B8			F8	
	39			79			B9			F9	
	3A			7A			BA		FLS_PR1	FA	RW
	3B			7B			BB			FB	
	3C			7C			BC			FC	
	3D			7D			BD			FD	
	3E			7E			BE		CPU_SCR1	FE	#
	3F			7F			BF		CPU_SCR0	FF	#

Blank fields are Reserved and must not be accessed.   # Access is bit specific.

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Electrical Specifications

This section presents the DC and AC electrical specifications of the CY8C21x23 PSoC device. For up to date electrical specifications, check if you have the latest data sheet by visiting the web at http://www.cypress.com/psoc.

Specifications are valid for -40°C $\leq$ T$_A$ $\leq$ 85°C and T$_J$ $\leq$ 100°C, except where noted.

Refer to Table 25 on page 25 for the electrical specifications on the internal main oscillator (IMO) using SLIMO mode.

Figure 10. Voltage versus CPU Frequency
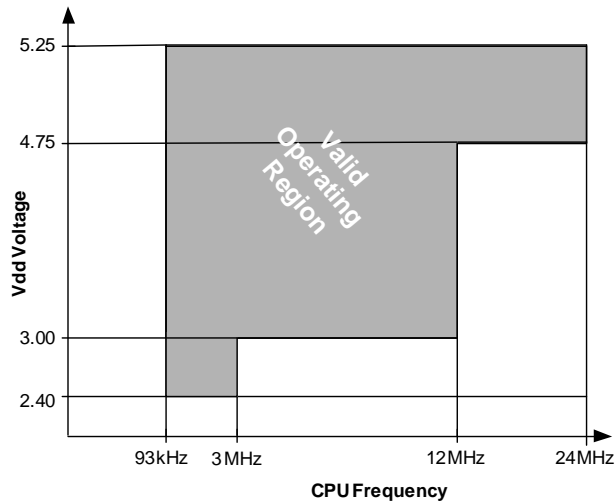
Figure 11. Voltage versus IMO Frequency
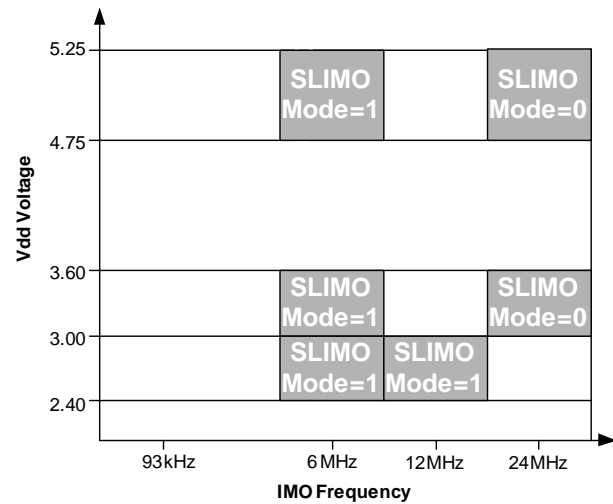
The following table lists the units of measure that are used in this section.

Table 11. Units of Measure

Symbol	Unit of Measure	Symbol	Unit of Measure
^{o}C	degree Celsius	μW	microwatts
dB	decibels	mA	milli-ampere
fF	femto farad	ms	milli-second
Hz	hertz	mV	milli-volts
KB	1024 bytes	nA	nanoampere
Kbit	1024 bits	ns	nanosecond
kHz	kilohertz	nV	nanovolts
kΩ	kilohm	W	ohm
MHz	megahertz	pA	picoampere
MΩ	megaohm	pF	picofarad
μA	microampere	pp	peak-to-peak
μF	microfarad	ppm	parts per million
μH	microhenry	ps	picosecond
μs	microsecond	sps	samples per second
μV	microvolts	s	sigma: one standard deviation
μVrms	microvolts root-mean-square	V	volts

Absolute Maximum Ratings

Exceeding maximum ratings may shorten the useful life of the device. User guidelines are not tested.

Table 12. Absolute Maximum Ratings

Symbol	Description	Min	Typ	Max	Units	Notes
T_{STG}	Storage Temperature	-55	–	+100	°C	Higher storage temperatures reduce data retention time. Recommended storage temperature is +25°C ± 25°C. Extended duration storage temperatures above 65°C degrade reliability.
T_A	Ambient Temperature with Power Applied	-40	–	+85	°C	
Vdd	Supply Voltage on Vdd Relative to Vss	-0.5	–	+6.0	V	
V_{IO}	DC Input Voltage	Vss - 0.5	–	Vdd + 0.5	V	
V_{IOZ}	DC Voltage Applied to Tristate	Vss - 0.5	–	Vdd + 0.5	V	
I_{MIO}	Maximum Current into any Port Pin	-25	–	+50	mA	
ESD	Electro Static Discharge Voltage	2000	–	–	V	Human Body Model ESD
LU	Latch up Current	–	–	200	mA	

Operating Temperature

Table 13. Operating Temperature

Symbol	Description	Min	Typ	Max	Units	Notes
T_A	Ambient Temperature	-40	–	+85	°C	
T_J	Junction Temperature	-40	–	+100	°C	The temperature rise from ambient to junction is package specific. See Table 37 on page 34. The user must limit the power consumption to comply with this requirement.

DC Electrical Characteristics

DC Chip-Level Specifications

Table 14 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C $\leq T_A \leq$ 85°C, 3.0V to 3.6V and -40°C $\leq T_A \leq$ 85°C, or 2.4V to 3.0V and -40°C $\leq T_A \leq$ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 14. DC Chip-Level Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
Vdd	Supply Voltage	2.40	–	5.25	V	See DC POR and LVD specifications, Table 21 on page 21.
I_{DD}	Supply Current, IMO = 24 MHz	–	3	4	mA	Conditions are Vdd = 5.0V, 25°C, CPU = 3 MHz, SYSCLK doubler disabled. VC1 = 1.5 MHz VC2 = 93.75 kHz VC3 = 0.366 kHz.
I_{DD3}	Supply Current, IMO = 6 MHz	–	1.2	2	mA	Conditions are Vdd = 3.3V, 25°C, CPU = 3 MHz, clock doubler disabled. VC1 = 375 kHz VC2 = 23.4 kHz VC3 = 0.091 kHz
I_{DD27}	Supply Current, IMO = 6 MHz	–	1.1	1.5	mA	Conditions are Vdd = 2.55V, 25°C, CPU = 3 MHz, clock doubler disabled. VC1 = 375 kHz VC2 = 23.4 kHz VC3 = 0.091 kHz
I_{SB27}	Sleep (Mode) Current with POR, LVD, Sleep Timer, WDT, and internal slow oscillator active. Mid temperature range.	–	2.6	4	µA	Vdd = 2.55V, 0°C to 40°C
I_{SB}	Sleep (Mode) Current with POR, LVD, Sleep Timer, WDT, and internal slow oscillator active.	–	2.8	5	µA	Vdd = 3.3V, -40°C $\leq T_A \leq$ 85°C
V_{REF}	Reference Voltage (Bandgap)	1.28	1.30	1.32	V	Trimmed for appropriate Vdd. Vdd = 3.0V to 5.25V
V_{REF27}	Reference Voltage (Bandgap)	1.16	1.30	1.330	V	Trimmed for appropriate Vdd. Vdd = 2.4V to 3.0V
AGND	Analog Ground	V_{REF} - 0.003	V_{REF}	V_{REF}+ 0.003	V	

DC General Purpose IO Specifications

Table 15 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C ≤ T$_A$ ≤ 85°C, 3.0V to 3.6V and -40°C ≤ T$_A$ ≤ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 15. 5V and 3.3V DC GPIO Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
R$_{PU}$	Pull up Resistor	4	5.6	8	kΩ	
R$_{PD}$	Pull down Resistor	4	5.6	8	kΩ	
V$_{OH}$	High Output Level	Vdd - 1.0	–	–	V	IOH = 10 mA, Vdd = 4.75 to 5.25V (8 total loads, 4 on even port pins (for example, P0[2], P1[4]), 4 on odd port pins (for example, P0[3], P1[5])). 80 mA maximum combined IOH budget.
V$_{OL}$	Low Output Level	–	–	0.75	V	IOL = 25 mA, Vdd = 4.75 to 5.25V (8 total loads, 4 on even port pins (for example, P0[2], P1[4]), 4 on odd port pins (for example, P0[3], P1[5])). 150 mA maximum combined IOL budget.
V$_{IL}$	Input Low Level	–	–	0.8	V	Vdd = 3.0 to 5.25
V$_{IH}$	Input High Level	2.1	–		V	Vdd = 3.0 to 5.25
V$_H$	Input Hysteresis	–	60	–	mV	
I$_{IL}$	Input Leakage (Absolute Value)	–	1	–	nA	Gross tested to 1 µA
C$_{IN}$	Capacitive Load on Pins as Input	–	3.5	10	pF	Package and pin dependent. Temp = 25°C
C$_{OUT}$	Capacitive Load on Pins as Output	–	3.5	10	pF	Package and pin dependent. Temp = 25°C

Table 16 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 2.4V to 3.0V and -40°C ≤ T$_A$ ≤ 85°C. Typical parameters apply to 2.7V at 25°C and are for design guidance only.

Table 16. 2.7V DC GPIO Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
R$_{PU}$	Pull up Resistor	4	5.6	8	kΩ	
R$_{PD}$	Pull down Resistor	4	5.6	8	kΩ	
V$_{OH}$	High Output Level	Vdd - 0.4	–	–	V	IOH = 2.5 mA (6.25 Typ), Vdd = 2.4 to 3.0V (16 mA maximum, 50 mA Typ combined IOH budget).
V$_{OL}$	Low Output Level	–	–	0.75	V	IOL = 10 mA, Vdd = 2.4 to 3.0V (90 mA maximum combined IOL budget).
V$_{IL}$	Input Low Level	–	–	0.75	V	Vdd = 2.4 to 3.0
V$_{IH}$	Input High Level	2.0	–	–	V	Vdd = 2.4 to 3.0
V$_H$	Input Hysteresis	–	60	–	mV	
I$_{IL}$	Input Leakage (Absolute Value)	–	1	–	nA	Gross tested to 1 µA
C$_{IN}$	Capacitive Load on Pins as Input	–	3.5	10	pF	Package and pin dependent. Temp = 25°C
C$_{OUT}$	Capacitive Load on Pins as Output	–	3.5	10	pF	Package and pin dependent. Temp = 25°C

[+] Feedback

DC Amplifier Specifications

The following tables list the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C $\leq T_A \leq$ 85°C, 3.0V to 3.6V and -40°C $\leq T_A \leq$ 85°C, or 2.4V to 3.0V and -40°C $\leq T_A \leq$ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 17. 5V DC Amplifier Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{OSOA}	Input Offset Voltage (absolute value)	–	2.5	15	mV	
TCV_{OSOA}	Average Input Offset Voltage Drift	–	10	–	μV/^{o}C	
I_{EBOA}	Input Leakage Current (Port 0 Analog Pins)	–	200	–	pA	Gross tested to 1 μA
C_{INOA}	Input Capacitance (Port 0 Analog Pins)	–	4.5	9.5	pF	Package and pin dependent. Temp = 25°C
V_{CMOA}	Common Mode Voltage Range	0.0	–	Vdd - 1	V	
G_{OLOA}	Open Loop Gain	80	–	–	dB	
I_{SOA}	Amplifier Supply Current	–	10	30	μA	

Table 18. 3.3V DC Amplifier Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{OSOA}	Input Offset Voltage (absolute value)	–	2.5	15	mV	
TCV_{OSOA}	Average Input Offset Voltage Drift	–	10	–	μV/^{o}C	
I_{EBOA}	Input Leakage Current (Port 0 Analog Pins)	–	200	–	pA	Gross tested to 1 μA
C_{INOA}	Input Capacitance (Port 0 Analog Pins)	–	4.5	9.5	pF	Package and pin dependent. Temp = 25°C
V_{CMOA}	Common Mode Voltage Range	0	–	Vdd - 1	V	
G_{OLOA}	Open Loop Gain	80	–	–	dB	
I_{SOA}	Amplifier Supply Current	–	10	30	μA	

Table 19. 2.7V DC Amplifier Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{OSOA}	Input Offset Voltage (absolute value)	–	2.5	15	mV	
TCV_{OSOA}	Average Input Offset Voltage Drift	–	10	–	μV/^{o}C	
I_{EBOA}	Input Leakage Current (Port 0 Analog Pins)	–	200	–	pA	Gross tested to 1 μA
C_{INOA}	Input Capacitance (Port 0 Analog Pins)	–	4.5	9.5	pF	Package and pin dependent. Temp = 25°C
V_{CMOA}	Common Mode Voltage Range	0	–	Vdd - 1	V	
G_{OLOA}	Open Loop Gain	80	–	–	dB	
I_{SOA}	Amplifier Supply Current	–	10	30	μA	

DC Switch Mode Pump Specifications

Table 20 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C ≤ T_A ≤ 85°C, 3.0V to 3.6V and -40°C ≤ T_A ≤ 85°C, or 2.4V to 3.0V and -40°C ≤ T_A ≤ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 20. DC Switch Mode Pump (SMP) Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{PUMP5V}	5V Output Voltage from Pump	4.75	5.0	5.25	V	Configuration of footnote.[6] Average, neglecting ripple. SMP trip voltage is set to 5.0V.
V_{PUMP3V}	3.3V Output Voltage from Pump	3.00	3.25	3.60	V	Configuration of footnote.[6] Average, neglecting ripple. SMP trip voltage is set to 3.25V.
V_{PUMP2V}	2.6V Output Voltage from Pump	2.45	2.55	2.80	V	Configuration of footnote.[6] Average, neglecting ripple. SMP trip voltage is set to 2.55V.
I_{PUMP}	Available Output Current V_{BAT} = 1.8V, V_{PUMP} = 5.0V V_{BAT} = 1.5V, V_{PUMP} = 3.25V V_{BAT} = 1.3V, V_{PUMP} = 2.55V	5 8 8	– – –	– – –	mA mA mA	Configuration of footnote.[6] SMP trip voltage is set to 5.0V. SMP trip voltage is set to 3.25V. SMP trip voltage is set to 2.55V.
V_{BAT5V}	Input Voltage Range from Battery	1.8	–	5.0	V	Configuration of footnote.[6] SMP trip voltage is set to 5.0V.
V_{BAT3V}	Input Voltage Range from Battery	1.0	–	3.3	V	Configuration of footnote.[6] SMP trip voltage is set to 3.25V.
V_{BAT2V}	Input Voltage Range from Battery	1.0	–	2.8	V	Configuration of footnote.[6] SMP trip voltage is set to 2.55V.
$V_{BATSTART}$	Minimum Input Voltage from Battery to Start Pump	1.2	–	–	V	Configuration of footnote.[6] 0°C ≤ T_A ≤ 100. 1.25V at T_A = -40°C.
ΔV_{PUMP_Line}	Line Regulation (over Vi range)	–	5	–	%V_O	Configuration of footnote.[6] V_O is the "Vdd Value for PUMP Trip" specified by the VM[2:0] setting in the DC POR and LVD Specification, Table 21 on page 21.
ΔV_{PUMP_Load}	Load Regulation	–	5	–	%V_O	Configuration of footnote.[6] V_O is the "Vdd Value for PUMP Trip" specified by the VM[2:0] setting in the DC POR and LVD Specification, Table 21 on page 21.
ΔV_{PUMP_Ripple}	Output Voltage Ripple (depends on cap/load)	–	100	–	mVpp	Configuration of footnote.[6] Load is 5 mA.
E_3	Efficiency	35	50	–	%	Configuration of footnote.[6] Load is 5 mA. SMP trip voltage is set to 3.25V.
E_2	Efficiency	35	80	–	%	For I load = 1mA, V_{PUMP} = 2.55V, V_{BAT} = 1.3V, 10 uH inductor, 1 uF capacitor, and Schottky diode.
F_{PUMP}	Switching Frequency	–	1.3	–	MHz	
DC_{PUMP}	Switching Duty Cycle	–	50	–	%	

Note

6. L_1 = 2 mH inductor, C_1 = 10 mF capacitor, D_1 = Schottky diode. See Figure 12 on page 21.

Figure 12. Basic Switch Mode Pump Circuit
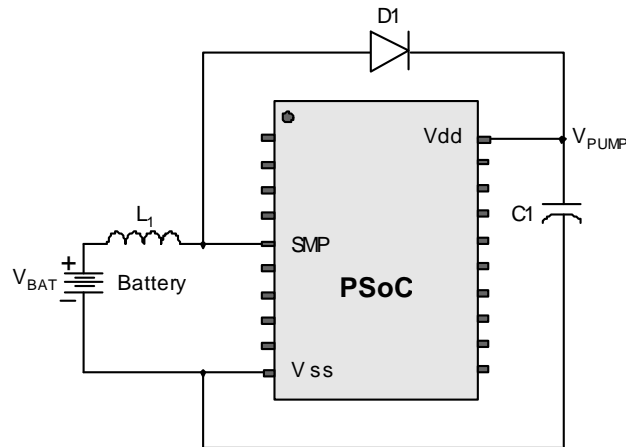
DC POR and LVD Specifications

Table 21 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C $\leq T_A \leq$ 85°C, 3.0V to 3.6V and -40°C $\leq T_A \leq$ 85°C, or 2.4V to 3.0V and -40°C $\leq T_A \leq$ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 21. DC POR and LVD Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{PPOR0} V_{PPOR1} V_{PPOR2}	Vdd Value for PPOR Trip PORLEV[1:0] = 00b PORLEV[1:0] = 01b PORLEV[1:0] = 10b	– 	2.36 2.82 4.55	2.40 2.95 4.70	V V V	Vdd must be greater than or equal to 2.5V during startup, reset from the XRES pin, or reset from Watchdog.
V_{LVD0} V_{LVD1} V_{LVD2} V_{LVD3} V_{LVD4} V_{LVD5} V_{LVD6} V_{LVD7}	Vdd Value for LVD Trip VM[2:0] = 000b VM[2:0] = 001b VM[2:0] = 010b VM[2:0] = 011b VM[2:0] = 100b VM[2:0] = 101b VM[2:0] = 110b VM[2:0] = 111b	2.40 2.85 2.95 3.06 4.37 4.50 4.62 4.71	2.45 2.92 3.02 3.13 4.48 4.64 4.73 4.81	2.51[7] 2.99[8] 3.09 3.20 4.55 4.75 4.83 4.95	V V V V V V V V	
V_{PUMP0} V_{PUMP1} V_{PUMP2} V_{PUMP3} V_{PUMP4} V_{PUMP5} V_{PUMP6} V_{PUMP7}	Vdd Value for PUMP Trip VM[2:0] = 000b VM[2:0] = 001b VM[2:0] = 010b VM[2:0] = 011b VM[2:0] = 100b VM[2:0] = 101b VM[2:0] = 110b VM[2:0] = 111b	2.45 2.96 3.03 3.18 4.54 4.62 4.71 4.89	2.55 3.02 3.10 3.25 4.64 4.73 4.82 5.00	2.62[9] 3.09 3.16 3.32[10] 4.74 4.83 4.92 5.12	V V V V V V V V	

Notes
7. Always greater than 50 mV above VPPOR (PORLEV = 00) for falling supply.
8. Always greater than 50 mV above VPPOR (PORLEV = 01) for falling supply.
9. Always greater than 50 mV above VLVD0.
10. Always greater than 50 mV above VLVD3.

DC Programming Specifications

Table 22 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C $\leq T_A \leq$ 85°C, 3.0V to 3.6V and -40°C $\leq T_A \leq$ 85°C, or 2.4V to 3.0V and -40°C $\leq T_A \leq$ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 22. DC Programming Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
Vdd$_{IWRITE}$	Supply Voltage for Flash Write Operations	2.70	–	–	V	
I$_{DDP}$	Supply Current During Programming or Verify	–	5	25	mA	
V$_{ILP}$	Input Low Voltage During Programming or Verify	–	–	0.8	V	
V$_{IHP}$	Input High Voltage During Programming or Verify	2.2	–	–	V	
I$_{ILP}$	Input Current when Applying Vilp to P1[0] or P1[1] During Programming or Verify	–	–	0.2	mA	Driving internal pull down resistor
I$_{IHP}$	Input Current when Applying Vihp to P1[0] or P1[1] During Programming or Verify	–	–	1.5	mA	Driving internal pull down resistor
V$_{OLV}$	Output Low Voltage During Programming or Verify	–	–	Vss + 0.75	V	
V$_{OHV}$	Output High Voltage During Programming or Verify	Vdd - 1.0	–	Vdd	V	
Flash$_{ENPB}$	Flash Endurance (per block)	50,000	–	–	–	Erase/write cycles per block
Flash$_{ENT}$	Flash Endurance (total)[11]	1,800,000	–	–	–	Erase/write cycles
Flash$_{DR}$	Flash Data Retention	10	–	–	Years	

Note
11. A maximum of 36 x 50,000 block endurance cycles is allowed. This may be balanced between operations on 36x1 blocks of 50,000 maximum cycles each, 36x2 blocks of 25,000 maximum cycles each, or 36x4 blocks of 12,500 maximum cycles each (and so forth to limit the total number of cycles to 36x50,000 and that no single block ever sees more than 50,000 cycles).For the full industrial range, the user must employ a temperature sensor user module (FlashTemp) and feed the result to the temperature argument before writing. Refer to the Flash APIs Application Note AN2015 at http://www.cypress.com under Application Notes for more information.

AC Electrical Characteristics

AC Chip-Level Specifications

Table 23 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C ≤ T_A ≤ 85°C, 3.0V to 3.6V and -40°C ≤ T_A ≤ 85°C, or 2.4V to 3.0V and -40°C ≤ T_A ≤ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 23. 5V and 3.3V AC Chip-Level Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{IMO24}	Internal Main Oscillator Frequency for 24 MHz	23.4	24	24.6[12,13,14]	MHz	Trimmed for 5V or 3.3V operation using factory trim values. See Figure 11 on page 15. SLIMO mode = 0.
F_{IMO6}	Internal Main Oscillator Frequency for 6 MHz	5.75	6	6.35[12,13,14]	MHz	Trimmed for 3.3V operation using factory trim values. See Figure 11 on page 15. SLIMO mode = 1.
F_{CPU1}	CPU Frequency (5V Nominal)	0.93	24	24.6[12,13]	MHz	24 MHz only for SLIMO mode = 0.
F_{CPU2}	CPU Frequency (3.3V Nominal)	0.93	12	12.3[13,14]	MHz	
F_{BLK5}	Digital PSoC Block Frequency (5V Nominal)	0	48	49.2[12,13,15]	MHz	Refer to the AC Digital Block Specifications.
F_{BLK33}	Digital PSoC Block Frequency (3.3V Nominal)	0	24	24.6[13,15]	MHz	
F_{32K1}	Internal Low Speed Oscillator Frequency	15	32	64	kHz	
Jitter32k	32 kHz RMS Period Jitter	–	100	200	ns	
Jitter32k	32 kHz Peak-to-Peak Period Jitter	–	1400	–	ns	
T_{XRST}	External Reset Pulse Width	10	–	–	µs	
DC24M	24 MHz Duty Cycle	40	50	60	%	
Step24M	24 MHz Trim Step Size	–	50	–	kHz	
Fout48M	48 MHz Output Frequency	46.8	48.0	49.2[12,14]	MHz	Trimmed. Using factory trim values.
Jitter24M1	24 MHz Peak-to-Peak Period Jitter (IMO)	–	300		ps	
F_{MAX}	Maximum frequency of signal on row input or row output.	–	–	12.3	MHz	
T_{RAMP}	Supply Ramp Time	0	–	–	µs	

Notes
12. 4.75V < Vdd < 5.25V.
13. Accuracy derived from Internal Main Oscillator with appropriate trim for Vdd range.
14. 3.0V < Vdd < 3.6V. See application note AN2012 "Adjusting PSoC Microcontroller Trims for Dual Voltage-Range Operation" for information on trimming for operation at 3.3V.
15. See the individual user module data sheets for information on maximum frequencies for user modules.

Table 24. 2.7V AC Chip-Level Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{IMO12}	Internal Main Oscillator Frequency for 12 MHz	11.5	12	12.7[16,17,18]	MHz	Trimmed for 2.7V operation using factory trim values. See Figure 11 on page 15. SLIMO mode = 1.
F_{IMO6}	Internal Main Oscillator Frequency for 6 MHz	5.5	6	6.35[16,17,18]	MHz	Trimmed for 2.7V operation using factory trim values. See Figure 11 on page 15. SLIMO mode = 1.
F_{CPU1}	CPU Frequency (2.7V Nominal)	0.093	3	3.15[16,17]	MHz	24 MHz only for SLIMO mode = 0.
F_{BLK27}	Digital PSoC Block Frequency (2.7V Nominal)	0	12	12.5[16,17,18]	MHz	Refer to the AC Digital Block Specifications.
F_{32K1}	Internal Low Speed Oscillator Frequency	8	32	96	kHz	
Jitter32k	32 kHz RMS Period Jitter	–	150	200	ns	
Jitter32k	32 kHz Peak-to-Peak Period Jitter	–	1400	–	ns	
T_{XRST}	External Reset Pulse Width	10	–	–	µs	
F_{MAX}	Maximum frequency of signal on row input or row output	–	–	12.3	MHz	
T_{RAMP}	Supply Ramp Time	0	–	–	µs	

Figure 13. 24 MHz Period Jitter (IMO) Timing Diagram
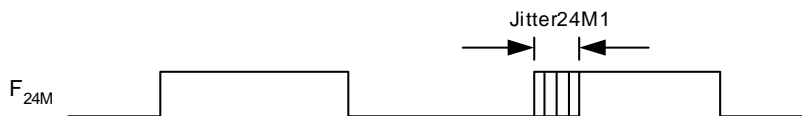
Figure 14. 32 kHz Period Jitter (ILO) Timing Diagram

Notes
16. 2.4V < Vdd < 3.0V.
17. Accuracy derived from Internal Main Oscillator with appropriate trim for Vdd range.
18. See application note AN2012 "Adjusting PSoC Microcontroller Trims for Dual Voltage-Range Operation" for information on maximum frequency for user modules.

[+] Feedback

AC General Purpose IO Specifications

Table 25 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C $\leq T_A \leq$ 85°C, 3.0V to 3.6V and -40°C $\leq T_A \leq$ 85°C, or 2.4V to 3.0V and -40°C $\leq T_A \leq$ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 25. 5V and 3.3V AC GPIO Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{GPIO}	GPIO Operating Frequency	0	–	12	MHz	Normal Strong Mode
TRiseF	Rise Time, Normal Strong Mode, Cload = 50 pF	3	–	18	ns	Vdd = 4.5 to 5.25V, 10% - 90%
TFallF	Fall Time, Normal Strong Mode, Cload = 50 pF	2	–	18	ns	Vdd = 4.5 to 5.25V, 10% - 90%
TRiseS	Rise Time, Slow Strong Mode, Cload = 50 pF	10	27	–	ns	Vdd = 3 to 5.25V, 10% - 90%
TFallS	Fall Time, Slow Strong Mode, Cload = 50 pF	10	22	–	ns	Vdd = 3 to 5.25V, 10% - 90%

Table 26. 2.7V AC GPIO Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{GPIO}	GPIO Operating Frequency	0	–	3	MHz	Normal Strong Mode
TRiseF	Rise Time, Normal Strong Mode, Cload = 50 pF	6	–	50	ns	Vdd = 2.4 to 3.0V, 10% - 90%
TFallF	Fall Time, Normal Strong Mode, Cload = 50 pF	6	–	50	ns	Vdd = 2.4 to 3.0V, 10% - 90%
TRiseS	Rise Time, Slow Strong Mode, Cload = 50 pF	18	40	120	ns	Vdd = 2.4 to 3.0V, 10% - 90%
TFallS	Fall Time, Slow Strong Mode, Cload = 50 pF	18	40	120	ns	Vdd = 2.4 to 3.0V, 10% - 90%

Figure 15. GPIO Timing Diagram
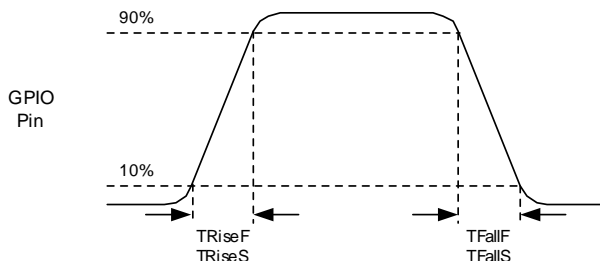
AC Amplifier Specifications

The following tables list the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C $\leq T_A \leq$ 85°C, 3.0V to 3.6V and -40°C $\leq T_A \leq$ 85°C, or 2.4V to 3.0V and -40°C $\leq T_A \leq$ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Settling times, slew rates, and gain bandwidth are based on the Analog Continuous Time PSoC block.

Table 27. 5V and 3.3V AC Amplifier Specifications

Symbol	Description	Min	Typ	Max	Units
T_{COMP1}	Comparator Mode Response Time, 50 mVpp Signal Centered on Ref			100	ns
T_{COMP2}	Comparator Mode Response Time, 2.5V Input, 0.5V Overdrive			300	ns

Table 28. 2.7V AC Amplifier Specifications

Symbol	Description	Min	Typ	Max	Units
T_{COMP1}	Comparator Mode Response Time, 50 mVpp Signal Centered on Ref			600	ns
T_{COMP2}	Comparator Mode Response Time, 1.5V Input, 0.5V Overdrive			300	ns

AC Digital Block Specifications

Table 29 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C ≤ T$_A$ ≤ 85°C, 3.0V to 3.6V and -40°C ≤ T$_A$ ≤ 85°C, or 2.4V to 3.0V and -40°C ≤ T$_A$ ≤ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 29. 5V and 3.3V AC Digital Block Specifications

Function	Description	Min	Typ	Max	Units	Notes
All Functions	Maximum Block Clocking Frequency (> 4.75V)			49.2	MHz	4.75V < Vdd < 5.25V
	Maximum Block Clocking Frequency (< 4.75V)			24.6	MHz	3.0V < Vdd < 4.75V
Timer	Capture Pulse Width	50[19]	–	–	ns	
	Maximum Frequency, No Capture	–	–	49.2	MHz	4.75V < Vdd < 5.25V
	Maximum Frequency, With or Without Capture	–	–	24.6	MHz	
Counter	Enable Pulse Width	50	–	–	ns	
	Maximum Frequency, No Enable Input	–	–	49.2	MHz	4.75V < Vdd < 5.25V
	Maximum Frequency, Enable Input	–	–	24.6	MHz	
Dead Band	Kill Pulse Width:					
	Asynchronous Restart Mode	20	–	–	ns	
	Synchronous Restart Mode	50	–	–	ns	
	Disable Mode	50	–	–	ns	
	Maximum Frequency	–	–	49.2	MHz	4.75V < Vdd < 5.25V
CRCPRS (PRS Mode)	Maximum Input Clock Frequency	–	–	49.2	MHz	4.75V < Vdd < 5.25V
CRCPRS (CRC Mode)	Maximum Input Clock Frequency	–	–	24.6	MHz	
SPIM	Maximum Input Clock Frequency	–	–	8.2	MHz	Maximum data rate at 4.1 MHz due to 2 x over clocking
SPIS	Maximum Input Clock Frequency	–	–	4.1	MHz	
	Width of SS_ Negated Between Transmissions	50	–	–	ns	
Transmitter	Maximum Input Clock Frequency	–	–	24.6	MHz	Maximum data rate at 3.08 MHz due to 8 x over clocking
Receiver	Maximum Input Clock Frequency	–	–	24.6	MHz	Maximum data rate at 3.08 MHz due to 8 x over clocking

Note
19. 50 ns minimum input pulse width is based on the input synchronizers running at 12 MHz (84 ns nominal period).

[+] Feedback

Table 30. 2.7V AC Digital Block Specifications

Function	Description	Min	Typ	Max	Units	Notes
All Functions	Maximum Block Clocking Frequency			12.7	MHz	2.4V < Vdd < 3.0V
Timer	Capture Pulse Width	100[20]	–	–	ns	
	Maximum Frequency, With or Without Capture	–	–	12.7	MHz	
Counter	Enable Pulse Width	100	–	–	ns	
	Maximum Frequency, No Enable Input	–	–	12.7	MHz	
	Maximum Frequency, Enable Input	–	–	12.7	MHz	
Dead Band	Kill Pulse Width:					
	Asynchronous Restart Mode	20	–	–	ns	
	Synchronous Restart Mode	100	–	–	ns	
	Disable Mode	100	–	–	ns	
	Maximum Frequency	–	–	12.7	MHz	
CRCPRS (PRS Mode)	Maximum Input Clock Frequency	–	–	12.7	MHz	
CRCPRS (CRC Mode)	Maximum Input Clock Frequency	–	–	12.7	MHz	
SPIM	Maximum Input Clock Frequency	–	–	6.35	MHz	Maximum data rate at 3.17 MHz due to 2 x over clocking
SPIS	Maximum Input Clock Frequency	–	–	4.1	MHz	
	Width of SS_ Negated Between Transmissions	100	–	–	ns	
Transmitter	Maximum Input Clock Frequency	–	–	12.7	MHz	Maximum data rate at 1.59 MHz due to 8 x over clocking
Receiver	Maximum Input Clock Frequency	–	–	12.7	MHz	Maximum data rate at 1.59 MHz due to 8 x over clocking

Note
20. 100 ns minimum input pulse width is based on the input synchronizers running at 12 MHz (84 ns nominal period).

[+] Feedback

AC External Clock Specifications

The following tables list the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C ≤ T_A ≤ 85°C, or 3.0V to 3.6V and -40°C ≤ T_A ≤ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 31. 5V AC External Clock Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{OSCEXT}	Frequency	0.093	–	24.6	MHz	
–	High Period	20.6	–	5300	ns	
–	Low Period	20.6	–	–	ns	
–	Power Up IMO to Switch	150	–	–	μs	

Table 32. 3.3V AC External Clock Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{OSCEXT}	Frequency with CPU Clock divide by 1	0.093	–	12.3	MHz	Maximum CPU frequency is 12 MHz at 3.3V. With the CPU clock divider set to 1, the external clock must adhere to the maximum frequency and duty cycle requirements.
F_{OSCEXT}	Frequency with CPU Clock divide by 2 or greater	0.186	–	24.6	MHz	If the frequency of the external clock is greater than 12 MHz, the CPU clock divider must be set to 2 or greater. In this case, the CPU clock divider ensures that the fifty percent duty cycle requirement is met.
–	High Period with CPU Clock divide by 1	41.7	–	5300	ns	
–	Low Period with CPU Clock divide by 1	41.7	–	–	ns	
–	Power Up IMO to Switch	150	–	–	μs	

Table 33. 2.7V AC External Clock Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{OSCEXT}	Frequency with CPU Clock divide by 1	0.093	–	6.06	MHz	Maximum CPU frequency is 3 MHz at 2.7V. With the CPU clock divider set to 1, the external clock must adhere to the maximum frequency and duty cycle requirements.
F_{OSCEXT}	Frequency with CPU Clock divide by 2 or greater	0.186	–	12.12	MHz	If the frequency of the external clock is greater than 3 MHz, the CPU clock divider must be set to 2 or greater. In this case, the CPU clock divider ensures that the fifty percent duty cycle requirement is met.
–	High Period with CPU Clock divide by 1	83.4	–	5300	ns	
–	Low Period with CPU Clock divide by 1	83.4	–	–	ns	
–	Power Up IMO to Switch	150	–	–	μs	

[+] Feedback

AC Programming Specifications

Table 34 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C ≤ T_A ≤ 85°C, or 3.0V to 3.6V and -40°C ≤ T_A ≤ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 34. AC Programming Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
T_{RSCLK}	Rise Time of SCLK	1	–	20	ns	
T_{FSCLK}	Fall Time of SCLK	1	–	20	ns	
T_{SSCLK}	Data Set up Time to Falling Edge of SCLK	40	–	–	ns	
T_{HSCLK}	Data Hold Time from Falling Edge of SCLK	40	–	–	ns	
F_{SCLK}	Frequency of SCLK	0	–	8	MHz	
T_{ERASEB}	Flash Erase Time (Block)	–	15	–	ms	
T_{WRITE}	Flash Block Write Time	–	30	–	ms	
T_{DSCLK3}	Data Out Delay from Falling Edge of SCLK	–	–	50	ns	3.0 ≤ Vdd ≤ 3.6
T_{DSCLK2}	Data Out Delay from Falling Edge of SCLK	–	–	70	ns	2.4 ≤ Vdd ≤ 3.0

AC I²C Specifications

Table 35 lists the guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C ≤ T_A ≤ 85°C, 3.0V to 3.6V and -40°C ≤ T_A ≤ 85°C, or 2.4V to 3.0V and -40°C ≤ T_A ≤ 85°C, respectively. Typical parameters apply to 5V, 3.3V, or 2.7V at 25°C and are for design guidance only.

Table 35. AC Characteristics of the I²C SDA and SCL Pins for Vcc ≥ 3.0V

Symbol	Description	Standard Mode		Fast Mode		Units
		Min	Max	Min	Max	
F_{SCLI2C}	SCL Clock Frequency	0	100	0	400	kHz
$T_{HDSTAI2C}$	Hold Time (repeated) START Condition. After this period, the first clock pulse is generated.	4.0	–	0.6	–	μs
T_{LOWI2C}	LOW Period of the SCL Clock	4.7	–	1.3	–	μs
$T_{HIGHI2C}$	HIGH Period of the SCL Clock	4.0	–	0.6	–	μs
$T_{SUSTAI2C}$	Setup Time for a Repeated START Condition	4.7	–	0.6	–	μs
$T_{HDDATI2C}$	Data Hold Time	0	–	0	–	μs
$T_{SUDATI2C}$	Data Setup Time	250	–	100[20]	–	ns
$T_{SUSTOI2C}$	Setup Time for STOP Condition	4.0	–	0.6	–	μs
T_{BUFI2C}	Bus Free Time Between a STOP and START Condition	4.7	–	1.3	–	μs
T_{SPI2C}	Pulse Width of spikes are suppressed by the input filter.	–	–	0	50	ns

Note
20. A Fast-Mode I2C-bus device can be used in a Standard-Mode I2C-bus system, but the requirement $t_{SU;DAT}$ ≥ 250 ns must then be met. This automatically becomes the case if the device does not stretch the LOW period of the SCL signal. If such device does stretch the LOW period of the SCL signal, it must output the next data bit to the SDA line t_{rmax} + $t_{SU;DAT}$ = 1000 + 250 = 1250 ns (according to the Standard-Mode I2C-bus specification) before the SCL line is released.

[+] Feedback

Table 36. 2.7V AC Characteristics of the I²C SDA and SCL Pins (Fast Mode Not Supported)

Symbol	Description	Standard Mode		Fast Mode		Units
		Min	Max	Min	Max	
F$_{SCLI2C}$	SCL Clock Frequency	0	100	–	–	kHz
T$_{HDSTAI2C}$	Hold Time (repeated) START Condition. After this period, the first clock pulse is generated.	4.0	–	–	–	μs
T$_{LOWI2C}$	LOW Period of the SCL Clock	4.7	–	–	–	μs
T$_{HIGHI2C}$	HIGH Period of the SCL Clock	4.0	–	–	–	μs
T$_{SUSTAI2C}$	Setup Time for a Repeated START Condition	4.7	–	–	–	μs
T$_{HDDATI2C}$	Data Hold Time	0	–	–	–	μs
T$_{SUDATI2C}$	Data Setup Time	250	–	–	–	ns
T$_{SUSTOI2C}$	Setup Time for STOP Condition	4.0	–	–	–	μs
T$_{BUFI2C}$	Bus Free Time Between a STOP and START Condition	4.7	–	–	–	μs
T$_{SPI2C}$	Pulse Width of spikes are suppressed by the input filter.	–	–	–	–	ns

Figure 16. Definition for Timing for Fast/Standard Mode on the I²C Bus
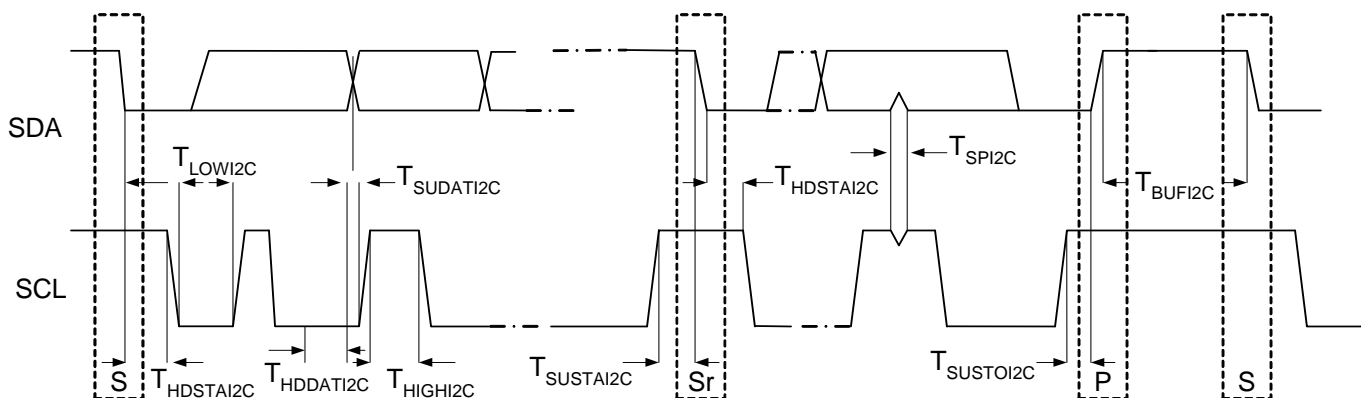
Packaging Information

This section illustrates the packaging specifications for the CY8C21x23 PSoC device, along with the thermal impedances for each package and minimum solder reflow peak temperature.

Important Note Emulation tools may require a larger area on the target PCB than the chip's footprint. For a detailed description of the emulation tools' dimensions, refer to the document titled *PSoC Emulator Pod Dimensions* at http://www.cypress.com/design/MR10161.

Packaging Dimensions

Figure 17. 8-Pin (150-Mil) SOIC

1. DIMENSIONS IN INCHES[MM] MIN.
                                    MAX.

2. PIN 1 ID IS OPTIONAL,
      ROUND ON SINGLE LEADFRAME
      RECTANGULAR ON MATRIX LEADFRAME

3. REFERENCE JEDEC MS-012

4. PACKAGE WEIGHT 0.07gms

PART #
S08.15 STANDARD PKG.
SZ08.15 LEAD FREE PKG.

51-85066 *C

[+] Feedback
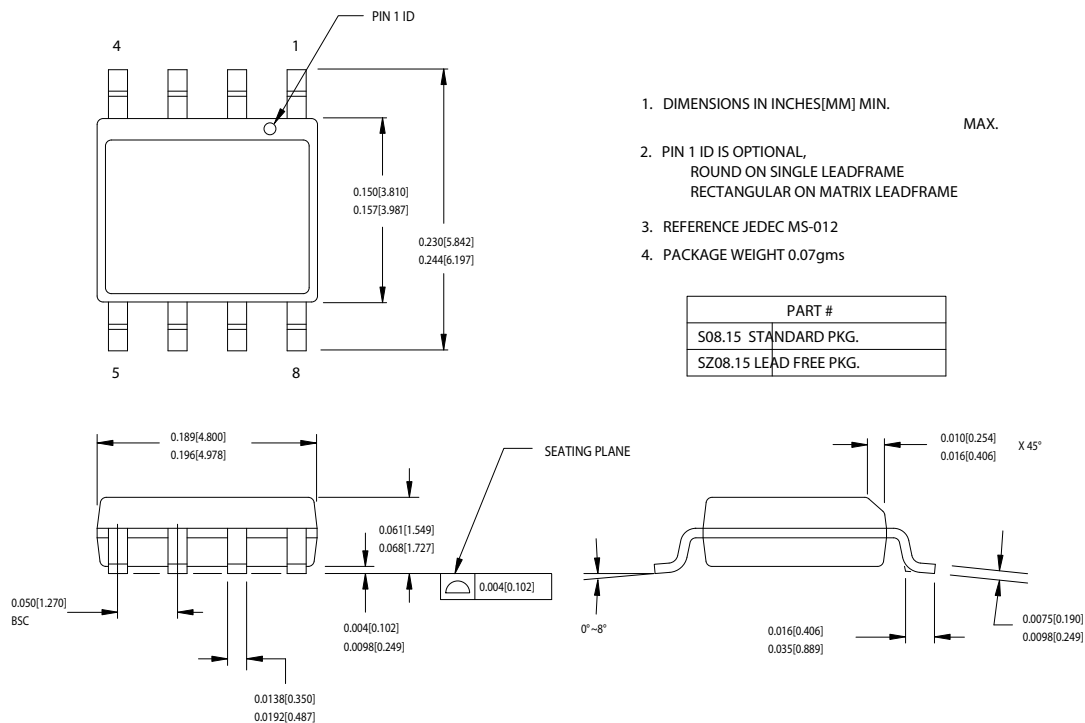
Figure 18. 16-Pin (150-Mil) SOIC
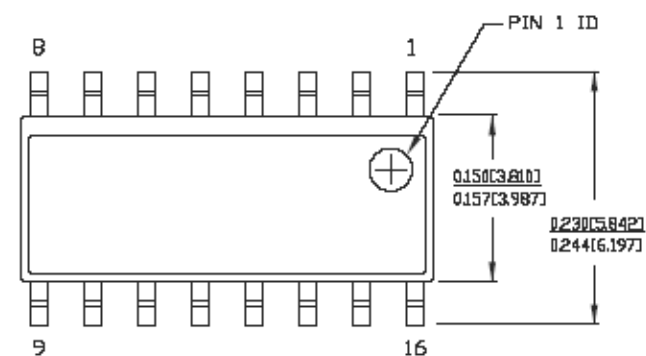
DIMENSIONS IN INCHES[MM] MIN.
MAX.

REFERENCE JEDEC MS-012

PACKAGE WEIGHT 0.15gms

PART #	
S16.15	STANDARD PKG.
SZ16.15	LEAD FREE PKG.

51-85022 *B
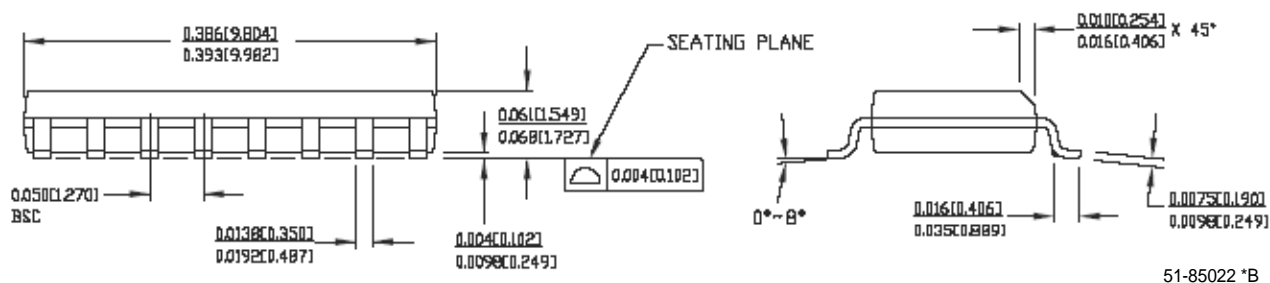
Figure 19. 16-Pin COL
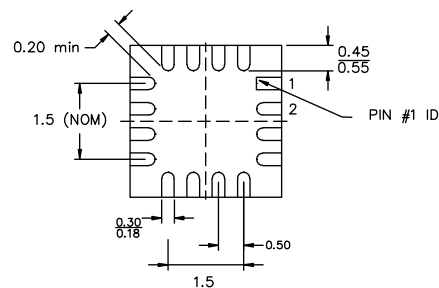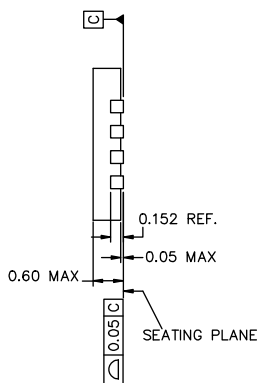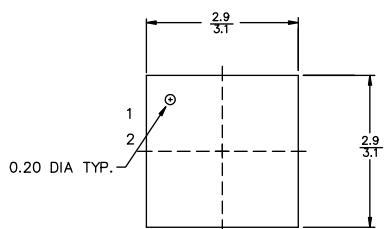
TOP VIEW   SIDE VIEW   BOTTOM VIEW

PART NO.	DESCRIPTION
LG16A	LEAD-FREE
LD16A	STANDARD

NOTES:

1. JEDEC # MO-220
2. Package Weight: 0.014g
3. DIMENSIONS IN MM, MIN
   MAX

001-09116 *D

Figure 20. 20-Pin (210-MIL) SSOP

DIMENSIONS IN MILLIMETERS $\frac{\text{MIN.}}{\text{MAX.}}$

51-85077 *C
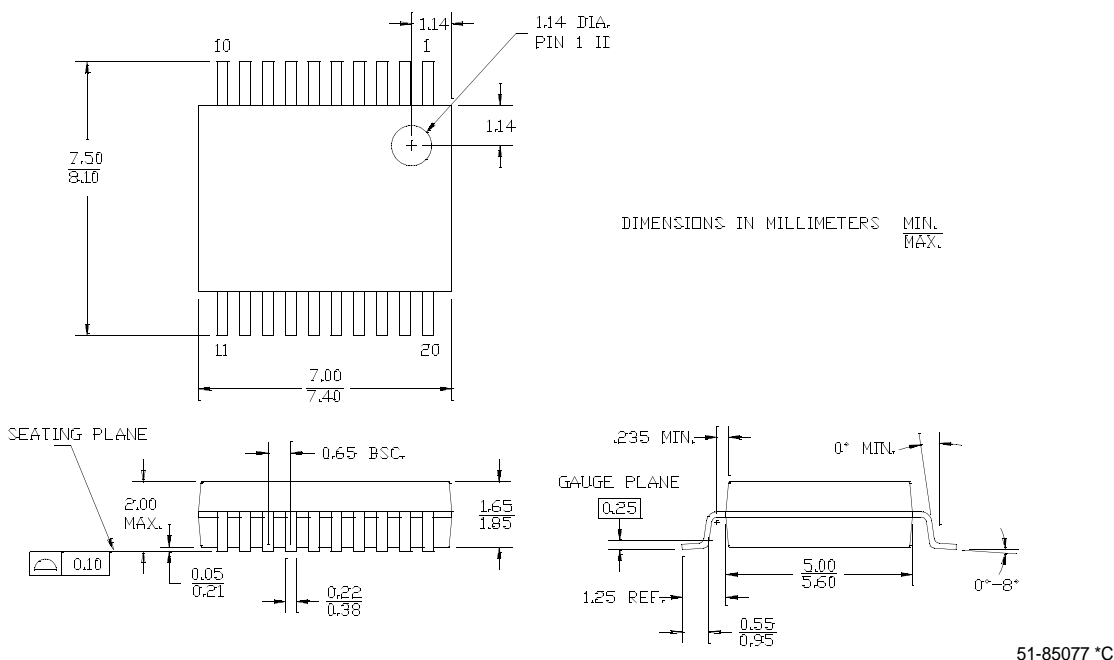
Figure 21. 24-Pin (4x4) QFN
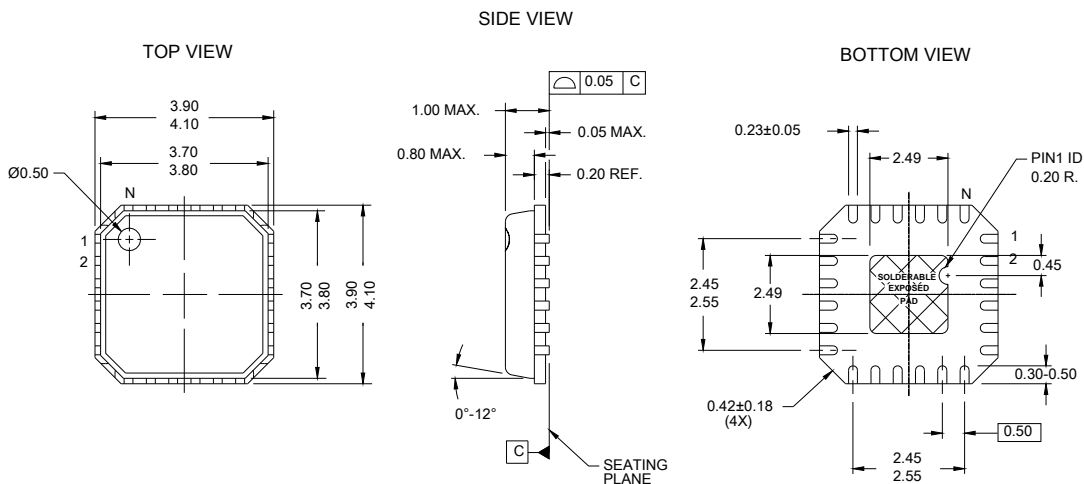
NOTES:

1. [hatch symbol] HATCH IS SOLDERABLE EXPOSED METAL.

2. REFERENCE JEDEC#: MO-220

3. PACKAGE WEIGHT: 0.042g

4. ALL DIMENSIONS ARE IN MM [MIN/MAX]

5. PACKAGE CODE

PART #	DESCRIPTION
LF24A	STANDARD
LY24A	LEAD FREE

51-85203 *A

Important Note For information on the preferred dimensions for mounting QFN packages, see the following Application Note at http://www.amkor.com/products/notes_papers/MLFAppNote.pdf.

Note that pinned vias for thermal conduction are not required for the low power 24, 32, and 48-pin QFN PSoC devices.

[+] Feedback

Thermal Impedances

Table 37. Thermal Impedances per Package

Package	Typical θ_{JA} [21]
8 SOIC	186°C/W
16 SOIC	125°C/W
16 COL	46°C/W
20 SSOP	117°C/W
24 QFN[22]	40°C/W

Solder Reflow Peak Temperature

Table 38 lists the minimum solder reflow peak temperature to achieve good solderability.

Table 38. Solder Reflow Peak Temperature

Package	Minimum Peak Temperature[23]	Maximum Peak Temperature
8 SOIC	240°C	260°C
16 SOIC	240°C	260°C
16 COL	240°C	260°C
20 SSOP	240°C	260°C
24 QFN	240°C	260°C

Notes
21. $T_J = T_A + POWER \times \theta_{JA}$
22. To achieve the thermal impedance specified for the QFN package, the center thermal pad must be soldered to the PCB ground plane.
23. Higher temperatures may be required based on the solder melting point. Typical temperatures for solder are 220+/-5°C with Sn-Pb or 245+/-5°C with Sn-Ag-Cu paste. Refer to the solder manufacturer specifications.

[+] Feedback

Ordering Information

The following table lists the CY8C21x23 PSoC device's key package features and ordering codes.

Table 39. CY8C21x23 PSoC Device Key Features and Ordering Information

Package	Ordering Code	Flash (Bytes)	RAM (Bytes)	Switch Mode Pump	Tempera-ture Range	Digital PSoC Blocks	Analog Blocks	Digital IO Pins	Analog Inputs	Analog Outputs	XRES Pin
8-Pin (150-Mil) SOIC	CY8C21123-24SXI	4K	256	No	-40°C to +85°C	4	4	6	4	0	No
8-Pin (150-Mil) SOIC (Tape and Reel)	CY8C21123-24SXIT	4K	256	No	-40°C to +85°C	4	4	6	4	0	No
16-Pin (150-Mil) SOIC	CY8C21223-24SXI	4K	256	Yes	-40°C to +85°C	4	4	12	8	0	No
16-Pin (150-Mil) SOIC (Tape and Reel)	CY8C21223-24SXIT	4K	256	Yes	-40°C to +85°C	4	4	12	8	0	No
16-Pin (3x3) COL	CY8C21223-24LGXI	4K	256	Yes	-40°C to +85°C	4	4	12	8	0	No
20-Pin (210-Mil) SSOP	CY8C21323-24PVXI	4K	256	No	-40°C to +85°C	4	4	16	8	0	Yes
20-Pin (210-Mil) SSOP (Tape and Reel)	CY8C21323-24PVXIT	4K	256	No	-40°C to +85°C	4	4	16	8	0	Yes
24-Pin (4x4) QFN	CY8C21323-24LFXI	4K	256	Yes	-40°C to +85°C	4	4	16	8	0	Yes
24-Pin (4x4) QFN (Tape and Reel)	CY8C21323-24LFXIT	4K	256	Yes	-40°C to +85°C	4	4	16	8	0	Yes

Note For Die sales information, contact a local Cypress sales office or Field Applications Engineer (FAE).

Ordering Code Definitions

CY 8 C 21 xxx-24xx
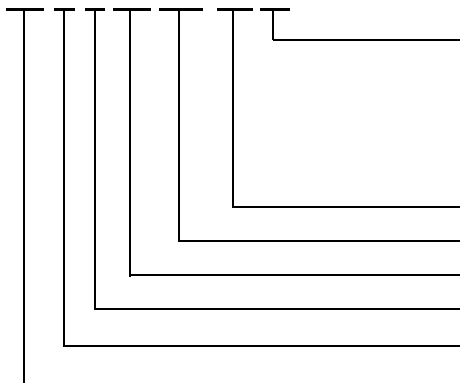
Package Type:
 PX = PDIP Pb-Free
 SX = SOIC Pb-Free
 PVX = SSOP Pb-Free
 LFX = QFN Pb-Free
 AX = TQFP Pb-Free

Thermal Rating:
 C = Commercial
 I = Industrial
 E = Extended

Speed: 24 MHz

Part Number

Family Code

Technology Code: C = CMOS

Marketing Code: 8 = Cypress PSoC

Company ID: CY = Cypress

[+] Feedback

Document History Page

	Document Title: CY8C21123, CY8C21223, CY8C21323 PSoC® Programmable System-on-Chip™ Document Number:38-12022			
Rev.	ECN No.	Orig. of Change	Submission Date	Description of Change
**	133248	NWJ	See ECN	New silicon and document (Revision **).
*A	208900	NWJ	See ECN	Add new part, new package and update all ordering codes to Pb-free.
*B	212081	NWJ	See ECN	Expand and prepare Preliminary version.
*C	227321	CMS Team	See ECN	Update specs., data, format.
*D	235973	SFV	See ECN	Updated Overview and Electrical Spec. chapters, along with 24-pin pinout. Added CMP_GO_EN register (1,64h) to mapping table.
*E	290991	HMT	See ECN	Update data sheet standards per SFV memo. Fix device table. Add part numbers to pinouts and fine tune. Change 20-pin SSOP to CY8C21323. Add Reflow Temp. table. Update diagrams and specs.
*F	301636	HMT	See ECN	DC Chip-Level Specification changes. Update links to new CY.com Portal.
*G	324073	HMT	See ECN	Obtained clearer 16 SOIC package. Update Thermal Impedances and Solder Reflow tables. Re-add pinout ISSP notation. Fix ADC type-o. Fix TMP register names. Update Electrical Specifications. Add CY logo. Update CY copyright. Make data sheet Final.
*H	2588457	KET/HMI/AESA	10/22/2008	New package information on page 9. Converted data sheet to new template. Added 16-Pin OFN package diagram.
*I	2618175	OGNE/PYRS	12/09/08	Added Note in Ordering Information Section. Changed title from PSoC Mixed-Signal Array to PSoC Programmable System-on-Chip. Updated 'Development Tools' and 'Designing with PSoC Designer' sections on pages 5 and 6
*J	2682782	MAXK/AESA	04/03/2009	Corrected 16 COL pinout.
*K	2699713	MAXK	04/29/09	Minor ECN to correct paragraph style of 16 COL Pinout. No change in content.

Sales, Solutions, and Legal Information

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[+] Feedback