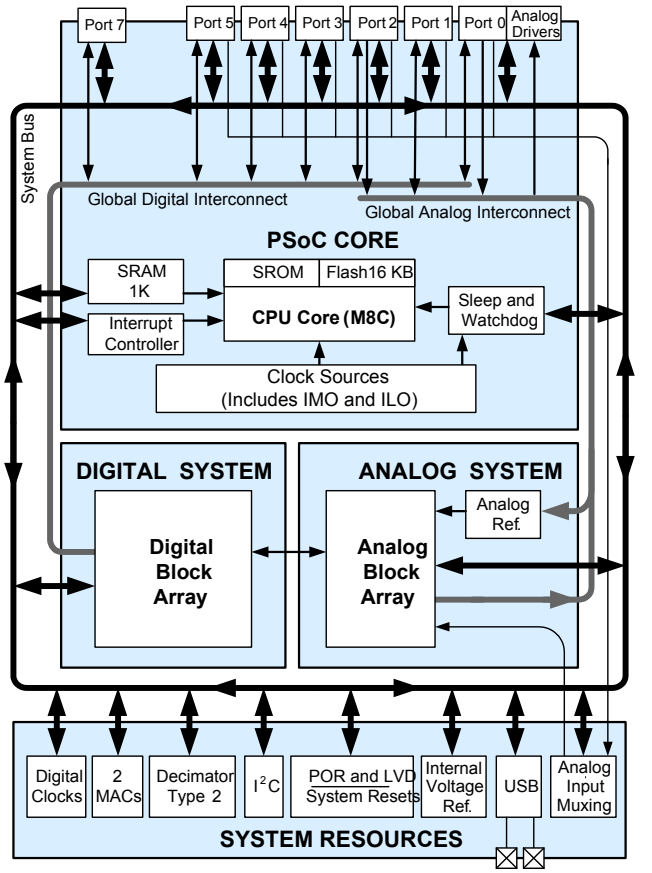
CY8C24094, CY8C24794
CY8C24894, CY8C24994

PSoC® Programmable System-on-Chip

1. Features

- XRES pin to support In-System Serial Programming (ISSP) and external reset control in CY8C24894
- Powerful Harvard-architecture processor
  - M8C processor speeds to 24 MHz
  - Two 8 × 8 multiply, 32-bit accumulate
  - Low power at high speed
  - 3 V to 5.25 V operating voltage
  - Industrial temperature range: –40 °C to +85 °C
  - USB temperature range: –10 °C to +85 °C
- Advanced peripherals (PSoC® Blocks)
  - Six rail-to-rail analog PSoC blocks provide:
    - Up to 14-bit analog-to-digital converters (ADCs)
    - Up to 9-bit digital-to-analog converters (DACs)
    - Programmable gain amplifiers (PGAs)
    - Programmable filters and comparators
  - Four digital PSoC blocks provide:
    - 8 to 32-bit timers, counters, and pulse width modulators (PWMs)
    - Cyclical redundancy check (CRC) and pseudo random sequence (PRS) modules
    - Full-duplex universal asynchronous receiver transmitter (UART)
    - Multiple serial peripheral interface (SPI) masters or slaves
    - Connectable to all general purpose I/O (GPIO) pins
  - Complex peripherals by combining blocks
  - Capacitive sensing application (CSA) capability
- Full-Speed USB (12 Mbps)
  - Four unidirectional endpoints
  - One bidirectional control endpoint
  - USB 2.0 compliant
  - Dedicated 256 byte buffer
  - No external crystal required
- Flexible on-chip memory
  - 16 KB flash program storage 50,000 erase and write cycles
  - 1 KB static random access memory (SRAM) data storage
  - ISSP
  - Partial flash updates
  - Flexible protection modes
  - Electrically erasable programmable read-only memory (EEPROM) emulation in flash
- Programmable pin configurations
  - 25 mA sink, 10 mA source on all GPIOs
  - Pull-up, pull-down, high Z, strong, or open drain drive modes on all GPIOs
  - Up to 48 analog inputs on GPIO
  - Two 33 mA analog outputs on GPIO
  - Configurable interrupt on all GPIOs
- Precision, programmable clocking
  - Internal ±4% 24- and 48- MHz oscillator
  - Internal oscillator for watchdog and sleep
  - 0.25% accuracy for USB with no external components
- Additional system resources
  - I^2C slave, master, and multi-master to 400 kHz
  - Watchdog and sleep timers
  - User-configurable low-voltage detection (LVD)

2. Logic Block Diagram



3. Contents

4. PSoC Functional Overview

The PSoC family consists of many devices with on-chip controllers. These devices are designed to replace multiple traditional MCU-based system components with one low-cost single-chip programmable component. A PSoC device includes configurable blocks of analog and digital logic, and programmable interconnect. This architecture makes it possible for you to create customized peripheral configurations, to match the requirements of each individual application. Additionally, a fast central processing unit (CPU), flash program memory, SRAM data memory, and configurable I/O are included in a range of convenient pinouts.

The PSoC architecture, shown in "" on page 1, consists of four main areas: the core, the system resources, the digital system, and the analog system. configurable global bus resources allow combining all of the device resources into a complete custom system. Each CY8C24x94 PSoC device includes four digital blocks and four analog blocks. Depending on the PSoC package, up to 28 GPIOs are also included. The GPIOs provide access to the global digital and analog interconnects.

4.1 The 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 internal main oscillator (IMO) and internal low speed oscillator (ILO). The CPU core, called the M8C, is a powerful processor with speeds up to 24 MHz. The M8C is a four-million instructions per second (MIPS) 8-bit Harvard-architecture microprocessor.

System resources provide these additional capabilities:

- Digital clocks for increased flexibility
- I^2C functionality to implement an I^2C master and slave
- An internal voltage reference, multi-master, that provides an absolute value of 1.3 V to a number of PSoC subsystems
- A switch mode pump (SMP) that generates normal operating voltages from a single battery cell
- Various system resets supported by the M8C

The digital system consists of an array of digital PSoC blocks that may be configured into any number of digital peripherals. The digital blocks are connected to the GPIOs through a series of global buses. These can route any signal to any pin, freeing 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 10 bits of precision.

4.2 The Digital System

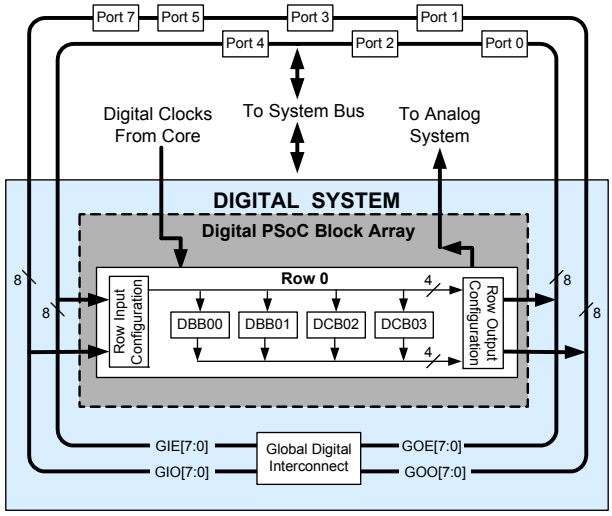
The digital system consists of four digital PSoC blocks. Each block is an 8-bit resource that is used alone or combined with other blocks to form 8-, 16-, 24-, and 32-bit peripherals, which are called user modules. Digital peripheral configurations include:

- 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
- SPI master and slave
- I^2C slave and multi-master
- CRC/generator (8-bit)
- IrDA
- PRS generators (8- to 32-bit)

The digital blocks are connected to any GPIO through a series of global buses that can route any signal to any pin. The buses also allow for signal multiplexing and for 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 allows the optimum choice of system resources for your application. Family resources are shown in Table 4-1 on page 5.

Figure 4-1. Digital System Block Diagram



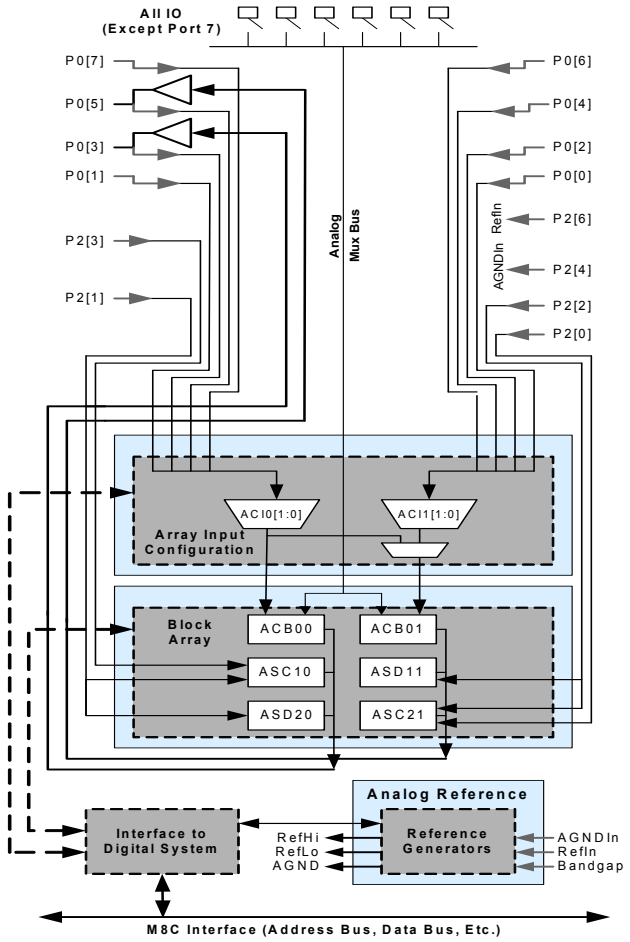
4.3 The Analog System

The analog system is composed of six configurable blocks, each comprised of an opamp circuit allowing the creation of complex analog signal flows. Analog peripherals are very flexible and can be customized to support specific application requirements. Some of the more common PSoC analog functions (most available as user modules) are as follows.

- ADCs (up to two, with 6- to 14-bit resolution, selectable as incremental, delta sigma, and SAR)
- Filters (2 and 4 pole band-pass, low-pass, and notch)
- Amplifiers (up to two, with selectable gain to 48x)
- Instrumentation amplifiers (one with selectable gain to 93x)
- Comparators (up to two, with 16 selectable thresholds)
- DACs (up to two, with 6- to 9-bit resolution)
- Multiplying DACs (up to two, with 6- to 9-bit resolution)
- High current output drivers (two with 30 mA drive as a PSoC core resource)
- 1.3-V reference (as a system resource)
- DTMF dialer
- Modulators
- Correlators
- Peak detectors
- Many other topologies possible

Analog blocks are arranged in a column of three, which includes one continuous time (CT) and two switched capacitor (SC) blocks, as shown in Figure 4-2.

Figure 4-2. Analog System Block Diagram



4.3.1 The Analog Multiplexer System

The analog mux bus can connect to every GPIO pin in ports 0-5. Pins are connected to the bus individually or in any combination. The bus also connects to the analog system for analysis with comparators and analog-to-digital converters. It is split into two sections for simultaneous dual-channel processing. An additional 8:1 analog input multiplexer provides a second path to bring Port 0 pins to the analog array.

Switch-control logic enables selected pins to precharge continuously under hardware control. This enables capacitive measurement for applications such as touch sensing. Other multiplexer applications include:

- Track pad, finger sensing
- Chip-wide mux that enables analog input from up to 48 I/O pins
- Crosspoint connection between any I/O pin combinations

4.4 Additional System Resources

System resources provide additional capability useful to complete systems. Additional resources include a multiplier, decimator, low-voltage detection, and power on reset. Brief statements describing the merits of each resource follow.

- Full-speed USB (12 Mbps) with five configurable endpoints and 256 bytes of RAM. No external components required except for two series resistors. Wider than commercial temperature USB operation –10°C to +85°C).
- 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 are generated using digital PSoC blocks as clock dividers.
- Two multiply accumulates (MACs) provide fast 8-bit multipliers with 32-bit accumulate, to assist in both general math and digital filters.
- Decimator provides a custom hardware filter for digital signal processing applications including creation of Delta Sigma ADCs.
- The I^2C module provides 100- and 400-kHz communication over two wires. Slave, master, multi-master are supported.
- Low voltage detection interrupts signal the application of falling voltage levels, while the advanced power-on reset (POR) circuit eliminates the need for a system supervisor.
- An internal 1.3-V reference provides an absolute reference for the analog system, including ADCs and DACs.
- Versatile analog multiplexer system.

4.5 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. The following table lists the resources available for specific PSoC device groups. The device covered by this data sheet is shown in the highlighted row of the table

Table 4-1. PSoC Device Characteristics

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

5. Getting Started

For in-depth information, along with detailed programming information, see the Technical Reference Manual for this PSoC device.

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

5.1 Application Notes

Cypress application notes are an excellent introduction to the wide variety of possible PSoC designs.

5.2 Development Kits

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

5.3 Training

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

5.4 CYPros Consultants

Certified PSoC Consultants offer everything from technical assistance to completed PSoC designs. To contact or become a PSoC Consultant go to the CYPros Consultants web site.

5.5 Solutions Library

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

5.6 Technical Support

Technical support – including a searchable Knowledge Base articles and technical forums – is also available online. If you cannot find an answer to your question, call our Technical Support hotline at 1-800-541-4736.

6. Development Tools

PSoC Designer™ is the revolutionary Integrated Design Environment (IDE) that you can use to customize PSoC to meet your specific application requirements. PSoC Designer software accelerates system design and time to market. Develop your applications using a library of precharacterized analog and digital peripherals (called user modules) in a drag-and-drop design environment. Then, customize your design by leveraging the dynamically generated application programming interface (API) libraries of code. Finally, debug and test your designs with the integrated debug environment, including in-circuit emulation and standard software debug features. PSoC Designer includes:

- Application editor graphical user interface (GUI) for device and user module configuration and dynamic reconfiguration
- Extensive user module catalog
- Integrated source-code editor (C and assembly)
- Free C compiler with no size restrictions or time limits
- Built-in debugger
- In-circuit emulation
- Built-in support for communication interfaces:
  - Hardware and software I^2C slaves and masters
  - Full-speed USB 2.0
  - Up to four full-duplex universal asynchronous receiver/transmitters (UARTs), SPI master and slave, and wireless

PSoC Designer supports the entire library of PSoC 1 devices and runs on Windows XP, Windows Vista, and Windows 7.

6.1 PSoC Designer Software Subsystems

6.1.1 Design Entry

In the chip-level view, choose a base device to work with. Then select different onboard analog and digital components that use the PSoC blocks, which are called user modules. Examples of user modules are analog-to-digital converters (ADCs), digital-to-analog converters (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 tool also supports easy development of multiple configurations and dynamic reconfiguration. Dynamic reconfiguration makes it possible to change configurations at run time. In essence, this allows you to use more than 100 percent of PSoC's resources for a given application.

6.1.2 Code Generation Tools

The code generation tools work seamlessly within the PSoC Designer interface and have been tested with a full range of debugging tools. You can develop your design in C, assembly, or a combination of the two.

Assemblers. The assemblers allow you to merge assembly code 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 of 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.

6.1.3 Debugger

PSoC Designer has a debug environment that 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 you to read and program and read and write data memory, and read and write I/O registers. You can read and write CPU registers, set and clear breakpoints, and provide program run, halt, and step control. The debugger also allows you to create a trace buffer of registers and memory locations of interest.

6.1.4 Online Help System

The online help system displays online, context-sensitive help. 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.

6.1.5 In-Circuit Emulator

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

The emulator consists of a base unit that connects to the PC using 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.

7. 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 is summarized in four steps:

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

7.1 Select User Modules

PSoC Designer provides a library of prebuilt, pretested hardware peripheral components called “user modules.” User modules make selecting and implementing peripheral devices, both analog and digital, simple.

7.2 Configure User Modules

Each user module that 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. All the user modules are documented in datasheets that may be viewed directly in PSoC Designer or on the Cypress website. These user module datasheets explain the internal operation of the user module and provide performance specifications. Each datasheet describes the use of each user module parameter, and other information you may need to successfully implement your design.

7.3 Organize and Connect

You build signal chains at the chip level by interconnecting user modules to each other and the I/O pins. You perform the selection, configuration, and routing so that you have complete control over all on-chip resources.

7.4 Generate, Verify, and Debug

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

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

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

8. Pin Information

This section describes, lists, and illustrates the CY8C24x94 PSoC device family pins and pinout configuration.

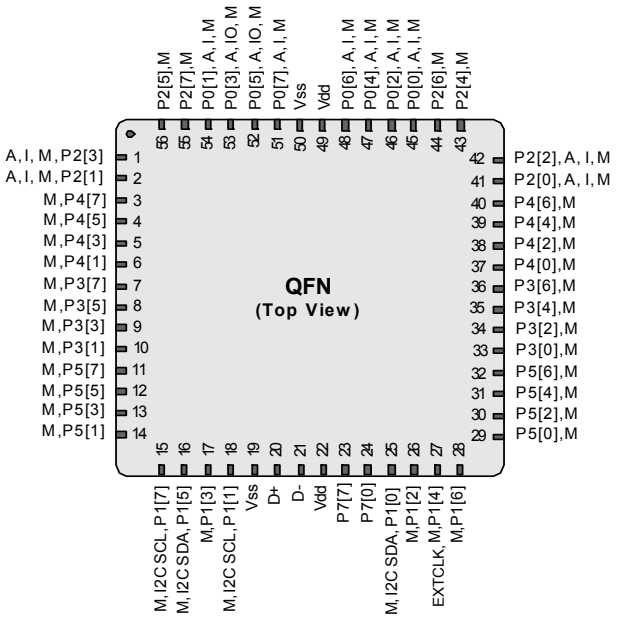
The CY8C24x94 PSoC devices are available in the following packages, all of which are shown on the following pages. Every port pin (labeled with a “P”) is capable of Digital I/O. However, V_{SS}, V_{DD}, and XRES are not capable of Digital I/O.

8.1 56-Pin Part Pinout

Table 8-1. 56-Pin Part Pinout (QFN[4]) See LEGEND details and footnotes in Table 8-2 **on page 9**.

Pin No.	Type		Name	Description
	Digital	Analog		
1	I/O	I, M	P2[3]	Direct switched capacitor block input
2	I/O	I, M	P2[1]	Direct switched capacitor block input
3	I/O	M	P4[7]	
4	I/O	M	P4[5]	
5	I/O	M	P4[3]	
6	I/O	M	P4[1]	
7	I/O	M	P3[7]	
8	I/O	M	P3[5]	
9	I/O	M	P3[3]	
10	I/O	M	P3[1]	
11	I/O	M	P5[7]	
12	I/O	M	P5[5]	
13	I/O	M	P5[3]	
14	I/O	M	P5[1]	
15	I/O	M	P1[7]	I^2C serial clock (SCL)
16	I/O	M	P1[5]	I^2C serial data (SDA)
17	I/O	M	P1[3]	
18	I/O	M	P1[1]	I^2C SCL, ISSP SCLK[3]
19	Power		V_{SS}	Ground connection
20	USB		D+	
21	USB		D-	
22	Power		V_{DD}	Supply voltage
23	I/O		P7[7]	
24	I/O		P7[0]	
25	I/O	M	P1[0]	I^2C SDA, ISSP SDATA[3]
26	I/O	M	P1[2]	
27	I/O	M	P1[4]	Optional external clock input (EXTCLK)
28	I/O	M	P1[6]	
29	I/O	M	P5[0]	
30	I/O	M	P5[2]	
31	I/O	M	P5[4]	
32	I/O	M	P5[6]	
33	I/O	M	P3[0]	
34	I/O	M	P3[2]	
35	I/O	M	P3[4]	
36	I/O	M	P3[6]	
37	I/O	M	P4[0]	
38	I/O	M	P4[2]	
39	I/O	M	P4[4]	
40	I/O	M	P4[6]	
41	I/O	I, M	P2[0]	Direct switched capacitor block input
42	I/O	I, M	P2[2]	Direct switched capacitor block input
43	I/O	M	P2[4]	External analog ground (AGND) input
44	I/O	M	P2[6]	External voltage reference (VREF) input
45	I/O	I, M	P0[0]	Analog column mux input
46	I/O	I, M	P0[2]	Analog column mux input
47	I/O	I, M	P0[4]	Analog column mux input VREF
48	I/O	I, M	P0[6]	Analog column mux input
49	Power		V_{DD}	Supply voltage
50	Power		V_{SS}	Ground connection
51	I/O	I, M	P0[7]	Analog column mux input
52	I/O	I/O, M	P0[5]	Analog column mux input and column output
53	I/O	I/O, M	P0[3]	Analog column mux input and column output
54	I/O	I, M	P0[1]	Analog column mux input
55	I/O	M	P2[7]	
56	I/O	M	P2[5]	

Figure 8-1. CY8C24794 56-Pin PSoC Device[1]



Notes
1. This part cannot be programmed with Reset mode; use Power Cycle mode when programming.
2. These are the ISSP pins, which are not High Z at POR. See the PSoC Technical Reference Manual for details.

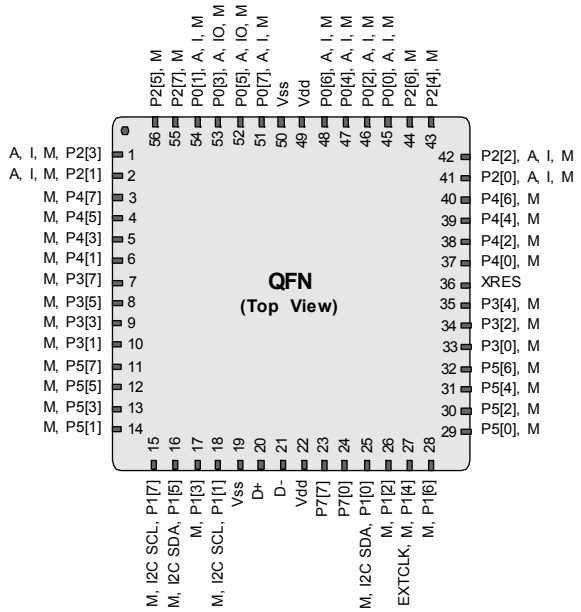
8.2 56-Pin Part Pinout (with XRES)

Table 8-2. 56-Pin Part Pinout (QFN[4])

Pin No.	Type		Name	Description
	Digital	Analog		
1	I/O	I, M	P2[3]	Direct switched capacitor block input
2	I/O	I, M	P2[1]	Direct switched capacitor block input
3	I/O	M	P4[7]	
4	I/O	M	P4[5]	
5	I/O	M	P4[3]	
6	I/O	M	P4[1]	
7	I/O	M	P3[7]	
8	I/O	M	P3[5]	
9	I/O	M	P3[3]	
10	I/O	M	P3[1]	
11	I/O	M	P5[7]	
12	I/O	M	P5[5]	
13	I/O	M	P5[3]	
14	I/O	M	P5[1]	
15	I/O	M	P1[7]	I^2C SCL
16	I/O	M	P1[5]	I^2C SDA
17	I/O	M	P1[3]	
18	I/O	M	P1[1]	I^2C SCL, ISSP SCLK[3]
19	Power		V_{SS}	Ground connection
20	USB		D+	
21	USB		D-	
22	Power		V_{DD}	Supply voltage
23	I/O		P7[7]	
24	I/O		P7[0]	
25	I/O	M	P1[0]	I^2C SDA, ISSP SDATA[3]
26	I/O	M	P1[2]	
27	I/O	M	P1[4]	Optional EXTCLK
28	I/O	M	P1[6]	
29	I/O	M	P5[0]	
30	I/O	M	P5[2]	
31	I/O	M	P5[4]	
32	I/O	M	P5[6]	
33	I/O	M	P3[0]	
34	I/O	M	P3[2]	
35	I/O	M	P3[4]	
36	Input		XRES	Active high external reset with internal pull-down
37	I/O	M	P4[0]	
38	I/O	M	P4[2]	
39	I/O	M	P4[4]	
40	I/O	M	P4[6]	
41	I/O	I, M	P2[0]	Direct switched capacitor block input
42	I/O	I, M	P2[2]	Direct switched capacitor block input
43	I/O	M	P2[4]	External AGND input
44	I/O	M	P2[6]	External VREF input
45	I/O	I, M	P0[0]	Analog column mux input
46	I/O	I, M	P0[2]	Analog column mux input
47	I/O	I, M	P0[4]	Analog column mux input VREF
48	I/O	I, M	P0[6]	Analog column mux input
49	Power		V_{DD}	Supply voltage
50	Power		V_{SS}	Ground connection
51	I/O	I, M	P0[7]	Analog column mux input
52	I/O	I/O, M	P0[5]	Analog column mux input and column output
53	I/O	I/O, M	P0[3]	Analog column mux input and column output
54	I/O	I, M	P0[1]	Analog column mux input
55	I/O	M	P2[7]	
56	I/O	M	P2[5]	

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

Figure 8-2. CY8C24894 56-Pin PSoC Device



Notes
3. These are the ISSP pins, which are not High Z at POR. See the PSoC Technical Reference Manual for details.
4. The center pad on the QFN package should be connected to ground (V_{SS}) for best mechanical, thermal, and electrical performance. If not connected to ground, it should be electrically floated and not connected to any other signal.

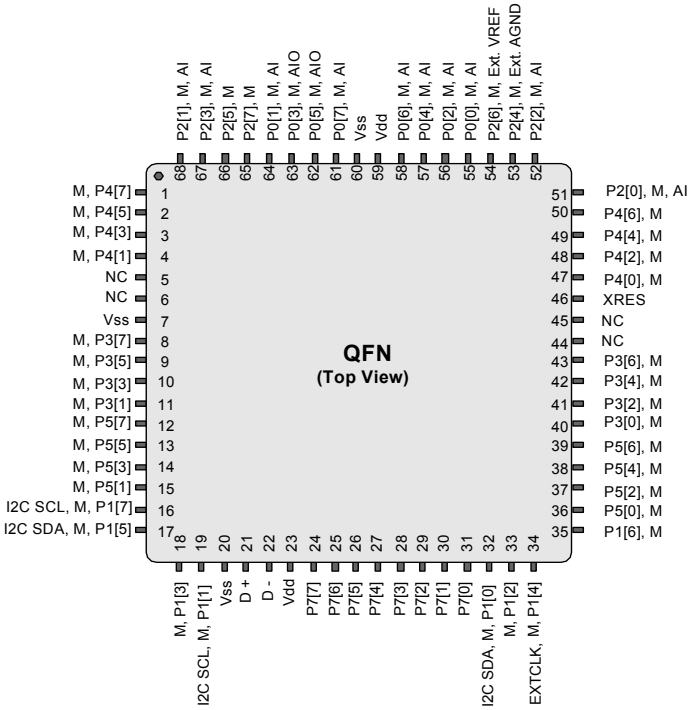
8.3 68-Pin Part Pinout

The following 68-pin QFN part table and drawing is for the CY8C24994 PSoC device.

Table 8-3. 68-Pin Part Pinout (QFN[5])

Pin No.	Type		Name	Description
	Digital	Analog		
1	I/O	M	P4[7]	
2	I/O	M	P4[5]	
3	I/O	M	P4[3]	
4	I/O	M	P4[1]	
5			NC	No connection
6			NC	No connection
7	Power		V_{SS}	Ground connection
8	I/O	M	P3[7]	
9	I/O	M	P3[5]	
10	I/O	M	P3[3]	
11	I/O	M	P3[1]	
12	I/O	M	P5[7]	
13	I/O	M	P5[5]	
14	I/O	M	P5[3]	
15	I/O	M	P5[1]	
16	I/O	M	P1[7]	I^2C SCL
17	I/O	M	P1[5]	I^2C SDA
18	I/O	M	P1[3]	
19	I/O	M	P1[1]	I2C SCL ISSP SCLK[6]
20	Power		V_{SS}	Ground connection
21	USB		D+	
22	USB		D-	
23	Power		V_{DD}	Supply voltage
24	I/O		P7[7]	
25	I/O		P7[6]	
26	I/O		P7[5]	
27	I/O		P7[4]	
28	I/O		P7[3]	
29	I/O		P7[2]	
30	I/O		P7[1]	
31	I/O		P7[0]	
32	I/O	M	P1[0]	I^2C SDA, ISSP SDATA[6]
33	I/O	M	P1[2]	
34	I/O	M	P1[4]	Optional EXTCLK
35	I/O	M	P1[6]	
36	I/O	M	P5[0]	
37	I/O	M	P5[2]	
38	I/O	M	P5[4]	
39	I/O	M	P5[6]	
40	I/O	M	P3[0]	
41	I/O	M	P3[2]	
42	I/O	M	P3[4]	
43	I/O	M	P3[6]	
44			NC	No connection.
45			NC	No connection.
46	Input		XRES	Active high pin reset with internal pull-down.
47	I/O	M	P4[0]	
48	I/O	M	P4[2]	
49	I/O	M	P4[4]	
50	I/O	M	P4[6]	
51	I/O	I,M	P2[0]	Direct switched capacitor block input
52	I/O	I,M	P2[2]	Direct switched capacitor block input
53	I/O	M	P2[4]	External AGND input
54	I/O	M	P2[6]	External VREF input
55	I/O	I,M	P0[0]	Analog column mux input
56	I/O	I,M	P0[2]	Analog column mux input and column output
57	I/O	I,M	P0[4]	Analog column mux input and column output
58	I/O	I,M	P0[6]	Analog column mux input
59	Power		V_{DD}	Supply voltage
60	Power		V_{SS}	Ground connection
61	I/O	I,M	P0[7]	Analog column mux input, integration input #1
62	I/O	I/O,M	P0[5]	Analog column mux input and column output, integration input #2
63	I/O	I/O,M	P0[3]	Analog column mux input and column output
64	I/O	I,M	P0[1]	Analog column mux input
65	I/O	M	P2[7]	
66	I/O	M	P2[5]	
67	I/O	I,M	P2[3]	Direct switched capacitor block input
68	I/O	I,M	P2[1]	Direct switched capacitor block input

Figure 8-3. CY8C24994 68-Pin PSoC Device



LEGENDA = Analog, I = Input, O = Output, NC = No Connection, M = Analog Mux Input.

Notes

5. The center pad on the QFN package should be connected to ground (V_{SS}) for best mechanical, thermal, and electrical performance. If not connected to ground, it should be electrically floated and not connected to any other signal.
6. These are the ISSP pins, which are not High Z at POR. See the PSoC Technical Reference Manual for details.

8.4 68-Pin Part Pinout (On-Chip Debug)

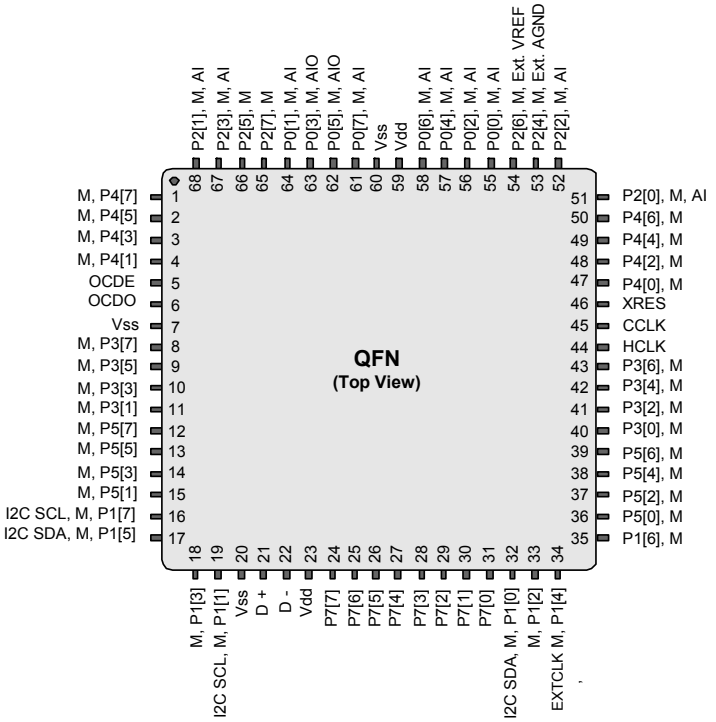
The following 68-pin QFN part table and drawing is for the CY8C24094 OCD PSoC device.

Note This part is only used for in-circuit debugging. It is NOT available for production.

Table 8-4. 68-Pin Part Pinout (QFN[7])

Pin No.	Type		Name	Description
	Digital	Analog		
1	I/O	M	P4[7]	
2	I/O	M	P4[5]	
3	I/O	M	P4[3]	
4	I/O	M	P4[1]	
5			OCDE	OCD even data I/O
6			OCDO	OCD odd data output
7	Power		V_{SS}	Ground connection
8	I/O	M	P3[7]	
9	I/O	M	P3[5]	
10	I/O	M	P3[3]	
11	I/O	M	P3[1]	
12	I/O	M	P5[7]	
13	I/O	M	P5[5]	
14	I/O	M	P5[3]	
15	I/O	M	P5[1]	
16	I/O	M	P1[7]	I^2C SCL
17	I/O	M	P1[5]	I^2C SDA
18	I/O	M	P1[3]	
19	I/O	M	P1[1]	I^2C SCL, ISSP SCLK[8]
20	Power		V_{SS}	Ground connection
21	USB		D+	
22	USB		D-	
23	Power		V_{DD}	Supply voltage
24	I/O		P7[7]	
25	I/O		P7[6]	
26	I/O		P7[5]	
27	I/O		P7[4]	
28	I/O		P7[3]	
29	I/O		P7[2]	
30	I/O		P7[1]	
31	I/O		P7[0]	
32	I/O	M	P1[0]	I^2C SDA, ISSP SDATA[8]
33	I/O	M	P1[2]	
34	I/O	M	P1[4]	Optional EXTCLK
35	I/O	M	P1[6]	
36	I/O	M	P5[0]	
37	I/O	M	P5[2]	
38	I/O	M	P5[4]	
39	I/O	M	P5[6]	
40	I/O	M	P3[0]	
41	I/O	M	P3[2]	
42	I/O	M	P3[4]	
43	I/O	M	P3[6]	
44			HCLK	OCD high speed clock output
45			CCLK	OCD CPU clock output
46	Input		XRES	Active high pin reset with internal pull-down
47	I/O	M	P4[0]	
48	I/O	M	P4[2]	
49	I/O	M	P4[4]	
50	I/O	M	P4[6]	
51	I/O	I,M	P2[0]	Direct switched capacitor block input
52	I/O	I,M	P2[2]	Direct switched capacitor block input
53	I/O	M	P2[4]	External AGND input
54	I/O	M	P2[6]	External VREF input
55	I/O	I,M	P0[0]	Analog column mux input
56	I/O	I,M	P0[2]	Analog column mux input and column output
57	I/O	I,M	P0[4]	Analog column mux input and column output
58	I/O	I,M	P0[6]	Analog column mux input
59	Power		V_{DD}	Supply voltage
60	Power		V_{SS}	Ground connection
61	I/O	I,M	P0[7]	Analog column mux input, integration input #1
62	I/O	I/O,M	P0[5]	Analog column mux input and column output, integration input #2
63	I/O	I/O,M	P0[3]	Analog column mux input and column output
64	I/O	I,M	P0[1]	Analog column mux input
65	I/O	M	P2[7]	
66	I/O	M	P2[5]	
67	I/O	I,M	P2[3]	Direct switched capacitor block input
68	I/O	I,M	P2[1]	Direct switched capacitor block input

Figure 8-4. CY8C24094 68-Pin OCD PSoC Device



LEGEND A = Analog, I = Input, O = Output, M = Analog Mux Input, OCD = On-Chip Debugger.

Notes

7. The center pad on the QFN package should be connected to ground (V_{SS}) for best mechanical, thermal, and electrical performance. If not connected to ground, it should be electrically floated and not connected to any other signal.
8. These are the ISSP pins, which are not High Z at POR. See the PSoC Technical Reference Manual for details.

8.5 100-Ball VFBGA Part Pinout

The 100-ball VFBGA part is for the CY8C24994 PSoC device.

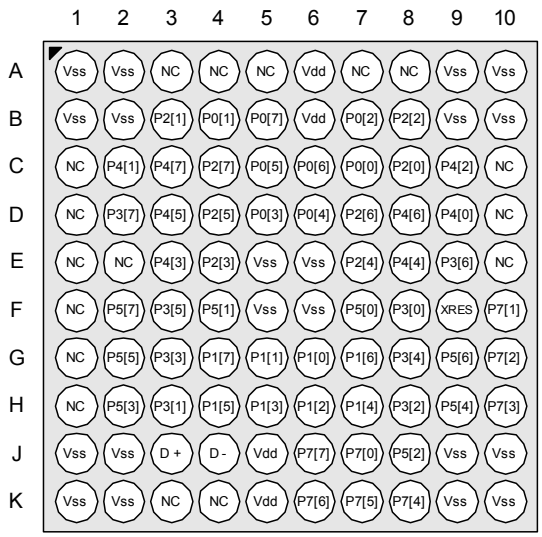
Table 8-5. 100-Ball Part Pinout (VFBGA)

Pin No.	Digital	Analog	Name	Description	Pin No.	Digital	Analog	Name	Description
A1	Power		V_{SS}	Ground connection	F1			NC	No connection
A2	Power		V_{SS}	Ground connection	F2	I/O	M	P5[7]	
A3			NC	No connection	F3	I/O	M	P3[5]	
A4			NC	No connection	F4	I/O	M	P5[1]	
A5			NC	No connection	F5	Power		V_{SS}	Ground connection
A6	Power		V_{DD}	Supply voltage	F6	Power		V_{SS}	Ground connection
A7			NC	No connection	F7	I/O	M	P5[0]	
A8			NC	No connection	F8	I/O	M	P3[0]	
A9	Power		V_{SS}	Ground connection	F9			XRES	Active high pin reset with internal pull-down
A10	Power		V_{SS}	Ground connection	F10	I/O		P7[1]	
B1	Power		V_{SS}	Ground connection	G1			NC	No connection
B2	Power		V_{SS}	Ground connection	G2	I/O	M	P5[5]	
B3	I/O	I,M	P2[1]	Direct switched capacitor block input	G3	I/O	M	P3[3]	
B4	I/O	I,M	P0[1]	Analog column mux input	G4	I/O	M	P1[7]	I^2C SCL
B5	I/O	I,M	P0[7]	Analog column mux input	G5	I/O	M	P1[1]	I^2C SCL, ISSP SCLK[9]
B6	Power		V_{DD}	Supply voltage	G6	I/O	M	P1[0]	I^2C SDA, ISSP SDATA[9]
B7	I/O	I,M	P0[2]	Analog column mux input	G7	I/O	M	P1[6]	
B8	I/O	I,M	P2[2]	Direct switched capacitor block input	G8	I/O	M	P3[4]	
B9	Power		V_{SS}	Ground connection	G9	I/O	M	P5[6]	
B10	Power		V_{SS}	Ground connection	G10	I/O		P7[2]	
C1			NC	No connection	H1			NC	No connection
C2	I/O	M	P4[1]		H2	I/O	M	P5[3]	
C3	I/O	M	P4[7]		H3	I/O	M	P3[1]	
C4	I/O	M	P2[7]		H4	I/O	M	P1[5]	I^2C SDA
C5	I/O	I/O,M	P0[5]	Analog column mux input and column output	H5	I/O	M	P1[3]	
C6	I/O	I,M	P0[6]	Analog column mux input	H6	I/O	M	P1[2]	
C7	I/O	I,M	P0[0]	Analog column mux input	H7	I/O	M	P1[4]	Optional EXTCLK
C8	I/O	I,M	P2[0]	Direct switched capacitor block input	H8	I/O	M	P3[2]	
C9	I/O	M	P4[2]		H9	I/O	M	P5[4]	
C10			NC	No connection	H10	I/O		P7[3]	
D1			NC	No connection	J1	Power		V_{SS}	Ground connection
D2	I/O	M	P3[7]		J2	Power		V_{SS}	Ground connection
D3	I/O	M	P4[5]		J3	USB		D+	
D4	I/O	M	P2[5]		J4	USB		D-	
D5	I/O	I/O,M	P0[3]	Analog column mux input and column output	J5	Power		V_{DD}	Supply voltage
D6	I/O	I,M	P0[4]	Analog column mux input	J6	I/O		P7[7]	
D7	I/O	M	P2[6]	External VREF input	J7	I/O		P7[0]	
D8	I/O	M	P4[6]		J8	I/O	M	P5[2]	
D9	I/O	M	P4[0]		J9	Power		V_{SS}	Ground connection
D10			NC	No connection	J10	Power		V_{SS}	Ground connection
E1			NC	No connection	K1	Power		V_{SS}	Ground connection
E2			NC	No connection	K2	Power		V_{SS}	Ground connection
E3	I/O	M	P4[3]		K3			NC	No connection
E4	I/O	I,M	P2[3]	Direct switched capacitor block input	K4			NC	No connection
E5	Power		V_{SS}	Ground connection	K5	Power		V_{DD}	Supply voltage
E6	Power		V_{SS}	Ground connection	K6	I/O		P7[6]	
E7	I/O	M	P2[4]	External AGND input	K7	I/O		P7[5]	
E8	I/O	M	P4[4]		K8	I/O		P7[4]	
E9	I/O	M	P3[6]		K9	Power		V_{SS}	Ground connection
E10			NC	No connection	K10	Power		V_{SS}	Ground connection

LEGENDA = Analog, I = Input, O = Output, M = Analog Mux Input, NC = No Connection.

Note
9. These are the ISSP pins, which are not High Z at POR. See the PSoC Technical Reference Manual for details.

Figure 8-5. CY8C24094 OCD (Not for Production)



BGA (Top View)

8.6 100-Ball VFBGA Part Pinout (On-Chip Debug)

The following 100-pin VFBGA part table and drawing is for the CY8C24094 OCD PSoC device.

Note This part is only used for in-circuit debugging. It is NOT available for production.

Table 8-6. 100-Ball Part Pinout (VFBGA)

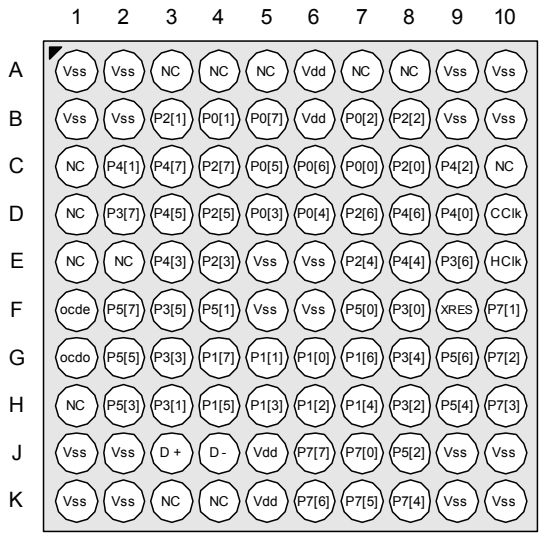
Pin No.	Digital	Analog	Name	Description	Pin No.	Digital	Analog	Name	Description
A1	Power		V_{SS}	Ground connection	F1			OCDE	OCD even data I/O
A2	Power		V_{SS}	Ground connection	F2	I/O	M	P5[7]	
A3			NC	No connection	F3	I/O	M	P3[5]	
A4			NC	No connection	F4	I/O	M	P5[1]	
A5			NC	No connection.	F5	Power		V_{SS}	Ground connection
A6	Power		V_{DD}	Supply voltage.	F6	Power		V_{SS}	Ground connection
A7			NC	No connection.	F7	I/O	M	P5[0]	
A8			NC	No connection.	F8	I/O	M	P3[0]	
A9	Power		V_{SS}	Ground connection	F9			XRES	Active high pin reset with internal pull-down
A10	Power		V_{SS}	Ground connection	F10	I/O		P7[1]	
B1	Power		V_{SS}	Ground connection	G1			OCDO	OCD odd data output
B2	Power		V_{SS}	Ground connection	G2	I/O	M	P5[5]	
B3	I/O	I,M	P2[1]	Direct switched capacitor block input	G3	I/O	M	P3[3]	
B4	I/O	I,M	P0[1]	Analog column mux input	G4	I/O	M	P1[7]	I^2C SCL
B5	I/O	I,M	P0[7]	Analog column mux input	G5	I/O	M	P1[1]	I^2C SCL, ISSP SCLK[10]
B6	Power		V_{DD}	Supply voltage	G6	I/O	M	P1[0]	I^2C SDA, ISSP SDATA[10]
B7	I/O	I,M	P0[2]	Analog column mux input	G7	I/O	M	P1[6]	
B8	I/O	I,M	P2[2]	Direct switched capacitor block input	G8	I/O	M	P3[4]	
B9	Power		V_{SS}	Ground connection	G9	I/O	M	P5[6]	
B10	Power		V_{SS}	Ground connection	G10	I/O		P7[2]	
C1			NC	No connection	H1			NC	No connection
C2	I/O	M	P4[1]		H2	I/O	M	P5[3]	
C3	I/O	M	P4[7]		H3	I/O	M	P3[1]	
C4	I/O	M	P2[7]		H4	I/O	M	P1[5]	I^2C SDA
C5	I/O	I/O, M	P0[5]	Analog column mux input and column output	H5	I/O	M	P1[3]	
C6	I/O	I,M	P0[6]	Analog column mux input	H6	I/O	M	P1[2]	
C7	I/O	I,M	P0[0]	Analog column mux input	H7	I/O	M	P1[4]	Optional EXTCLK
C8	I/O	I,M	P2[0]	Direct switched capacitor block input	H8	I/O	M	P3[2]	
C9	I/O	M	P4[2]		H9	I/O	M	P5[4]	
C10			NC	No connection	H10	I/O		P7[3]	
D1			NC	No connection	J1	Power		V_{SS}	Ground connection
D2	I/O	M	P3[7]		J2	Power		V_{SS}	Ground connection
D3	I/O	M	P4[5]		J3	USB		D+	
D4	I/O	M	P2[5]		J4	USB		D-	
D5	I/O	I/O, M	P0[3]	Analog column mux input and column output	J5	Power		V_{DD}	Supply voltage
D6	I/O	I,M	P0[4]	Analog column mux input	J6	I/O		P7[7]	
D7	I/O	M	P2[6]	External VREF input	J7	I/O		P7[0]	
D8	I/O	M	P4[6]		J8	I/O	M	P5[2]	
D9	I/O	M	P4[0]		J9	Power		V_{SS}	Ground connection
D10			CCLK	OCD CPU clock output	J10	Power		V_{SS}	Ground connection
E1			NC	No connection	K1	Power		V_{SS}	Ground connection
E2			NC	No connection	K2	Power		V_{SS}	Ground connection
E3	I/O	M	P4[3]		K3			NC	No connection
E4	I/O	I,M	P2[3]	Direct switched capacitor block input	K4			NC	No connection
E5	Power		V_{SS}	Ground connection	K5	Power		V_{DD}	Supply voltage
E6	Power		V_{SS}	Ground connection	K6	I/O		P7[6]	
E7	I/O	M	P2[4]	External AGND input	K7	I/O		P7[5]	
E8	I/O	M	P4[4]		K8	I/O		P7[4]	
E9	I/O	M	P3[6]		K9	Power		V_{SS}	Ground connection
E10			HCLK	OCD high speed clock output	K10	Power		V_{SS}	Ground connection

LEGEND A = Analog, I = Input, O = Output, M = Analog Mux Input, NC = No Connection, OCD = On-Chip Debugger.

Note

10. These are the ISSP pins, which are not High Z at POR. See the PSoC Technical Reference Manual for details.

Figure 8-6. CY8C24094 OCD (Not for Production)



BGA (Top View)

8.7 100-Pin Part Pinout (On-Chip Debug)

The 100-pin TQFP part is for the CY8C24094 OCD PSoC device.

Note This part is only used for in-circuit debugging. It is NOT available for production.

Table 8-7. 100-Pin Part Pinout (TQFP)

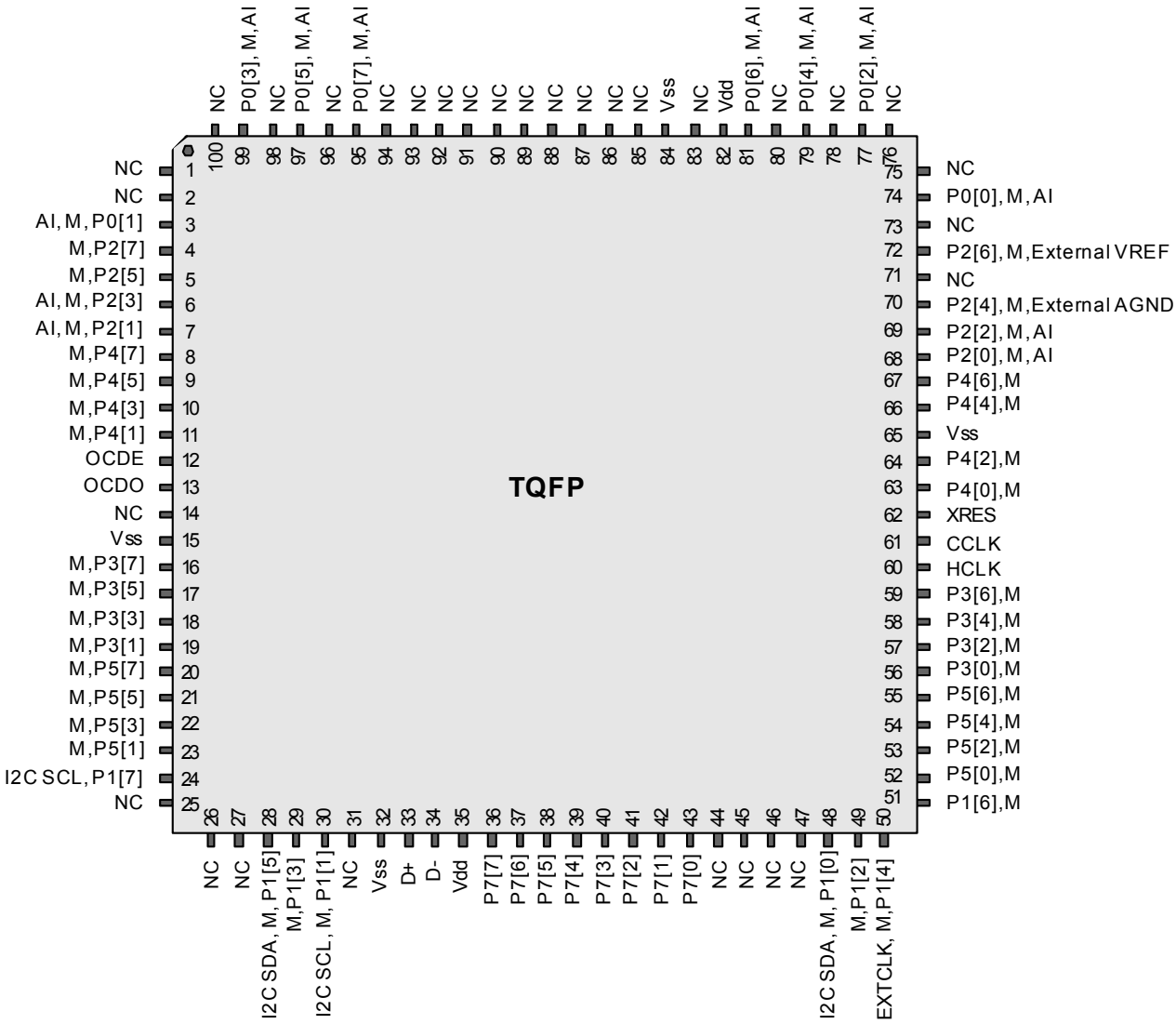
Pin No.	Digital	Analog	Name	Description	Pin No.	Digital	Analog	Name	Description
1			NC	No connection	51	I/O	M	P1[6]	
2			NC	No connection	52	I/O	M	P5[0]	
3	I/O	I, M	P0[1]	Analog column mux input	53	I/O	M	P5[2]	
4	I/O	M	P2[7]		54	I/O	M	P5[4]	
5	I/O	M	P2[5]		55	I/O	M	P5[6]	
6	I/O	I, M	P2[3]	Direct switched capacitor block input	56	I/O	M	P3[0]	
7	I/O	I, M	P2[1]	Direct switched capacitor block input	57	I/O	M	P3[2]	
8	I/O	M	P4[7]		58	I/O	M	P3[4]	
9	I/O	M	P4[5]		59	I/O	M	P3[6]	
10	I/O	M	P4[3]		60			HCLK	OCD high speed clock output
11	I/O	M	P4[1]		61			CCLK	OCD CPU clock output
12			OCDE	OCD even data I/O	62	Input		XRES	Active high pin reset with internal pull-down
13			OCDO	OCD odd data output	63	I/O	M	P4[0]	
14			NC	No connection	64	I/O	M	P4[2]	
15	Power		V_{SS}	Ground connection	65	Power		V_{SS}	Ground connection
16	I/O	M	P3[7]		66	I/O	M	P4[4]	
17	I/O	M	P3[5]		67	I/O	M	P4[6]	
18	I/O	M	P3[3]		68	I/O	I, M	P2[0]	Direct switched capacitor block input
19	I/O	M	P3[1]		69	I/O	I, M	P2[2]	Direct switched capacitor block input
20	I/O	M	P5[7]		70	I/O		P2[4]	External AGND input
21	I/O	M	P5[5]		71			NC	No connection
22	I/O	M	P5[3]		72	I/O		P2[6]	External VREF input
23	I/O	M	P5[1]		73			NC	No connection
24	I/O	M	P1[7]	I^2C SCL	74	I/O	I	P0[0]	Analog column mux input
25			NC	No connection	75			NC	No connection
26			NC	No connection	76			NC	No connection
27			NC	No connection	77	I/O	I, M	P0[2]	Analog column mux input and column output
28	I/O		P1[5]	I^2C SDA	78			NC	No connection
29	I/O		P1[3]		79	I/O	I, M	P0[4]	Analog column mux input and column output
30	I/O		P1[1]	Crystal (XTALin), I2C SCL, ISSP SCLK[11]	80			NC	No connection
31			NC	No connection	81	I/O	I, M	P0[6]	Analog column mux input
32	Power		V_{SS}	Ground connection	82	Power		V_{DD}	Supply voltage
33	USB		D+		83			NC	No connection
34	USB		D-		84	Power		V_{SS}	Ground connection
35	Power		V_{DD}	Supply voltage	85			NC	No connection
36	I/O		P7[7]		86			NC	No connection
37	I/O		P7[6]		87			NC	No connection
38	I/O		P7[5]		88			NC	No connection
39	I/O		P7[4]		89			NC	No connection
40	I/O		P7[3]		90			NC	No connection
41	I/O		P7[2]		91			NC	No connection
42	I/O		P7[1]		92			NC	No connection
43	I/O		P7[0]		93			NC	No connection
44			NC	No connection	94			NC	No connection
45			NC	No connection	95	I/O	I, M	P0[7]	Analog column mux input
46			NC	No connection	96			NC	No connection
47			NC	No connection	97	I/O	I/O, M	P0[5]	Analog column mux input and column output
48	I/O		P1[0]	Crystal (XTALout), I2C SDA, ISSP SDATA[11]	98			NC	No connection
49	I/O		P1[2]		99	I/O	I/O, M	P0[3]	Analog column mux input and column output
50	I/O		P1[4]	Optional EXTCLK	100			NC	No connection

LEGEND A = Analog, I = Input, O = Output, NC = No Connection, M = Analog Mux Input, OCD = On-Chip Debugger.

Note

11. These are the ISSP pins, which are not High Z at POR. See the PSoC Technical Reference Manual for details.

Figure 8-7. CY8C24094 OCD (Not for Production)



9. Register Reference

This section lists the registers of the CY8C24x94 PSoC device family. For detailed register information, see the *PSoC Technical Reference Manual*.

9.1 Register Conventions

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

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

9.2 Register Mapping Tables

The PSoC device has a total register address space of 512 bytes. The register space is referred to as I/O 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 should not be accessed.

9.3 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	PMA0_DR	40	RW	ASC10CR0	80	RW		C0	
PRT0IE	01	RW	PMA1_DR	41	RW	ASC10CR1	81	RW		C1	
PRT0GS	02	RW	PMA2_DR	42	RW	ASC10CR2	82	RW		C2	
PRT0DM2	03	RW	PMA3_DR	43	RW	ASC10CR3	83	RW		C3	
PRT1DR	04	RW	PMA4_DR	44	RW	ASD11CR0	84	RW		C4	
PRT1IE	05	RW	PMA5_DR	45	RW	ASD11CR1	85	RW		C5	
PRT1GS	06	RW	PMA6_DR	46	RW	ASD11CR2	86	RW		C6	
PRT1DM2	07	RW	PMA7_DR	47	RW	ASD11CR3	87	RW		C7	
PRT2DR	08	RW	USB_SOF0	48	R		88			C8	
PRT2IE	09	RW	USB_SOF1	49	R		89			C9	
PRT2GS	0A	RW	USB_CR0	4A	RW		8A			CA	
PRT2DM2	0B	RW	USBI/O_CR0	4B	#		8B			CB	
PRT3DR	0C	RW	USBI/O_CR1	4C	RW		8C			CC	
PRT3IE	0D	RW		4D			8D			CD	
PRT3GS	0E	RW	EP1_CNT1	4E	#		8E			CE	
PRT3DM2	0F	RW	EP1_CNT	4F	RW		8F			CF	
PRT4DR	10	RW	EP2_CNT1	50	#	ASD20CR0	90	RW	CUR_PP	D0	RW
PRT4IE	11	RW	EP2_CNT	51	RW	ASD20CR1	91	RW	STK_PP	D1	RW
PRT4GS	12	RW	EP3_CNT1	52	#	ASD20CR2	92	RW		D2	
PRT4DM2	13	RW	EP3_CNT	53	RW	ASD20CR3	93	RW	IDX_PP	D3	RW
PRT5DR	14	RW	EP4_CNT1	54	#	ASC21CR0	94	RW	MVR_PP	D4	RW
PRT5IE	15	RW	EP4_CNT	55	RW	ASC21CR1	95	RW	MVW_PP	D5	RW
PRT5GS	16	RW	EP0_CR	56	#	ASC21CR2	96	RW	I2C_CFG	D6	RW
PRT5DM2	17	RW	EP0_CNT	57	#	ASC21CR3	97	RW	I2C_SCR	D7	#
	18		EP0_DR0	58	RW		98		I2C_DR	D8	RW
	19		EP0_DR1	59	RW		99		I2C_MSCR	D9	#
	1A		EP0_DR2	5A	RW		9A		INT_CLR0	DA	RW
	1B		EP0_DR3	5B	RW		9B		INT_CLR1	DB	RW
PRT7DR	1C	RW	EP0_DR4	5C	RW		9C		INT_CLR2	DC	RW
PRT7IE	1D	RW	EP0_DR5	5D	RW		9D		INT_CLR3	DD	RW
PRT7GS	1E	RW	EP0_DR6	5E	RW		9E		INT_MSK3	DE	RW
PRT7DM2	1F	RW	EP0_DR7	5F	RW		9F		INT_MSK2	DF	RW
DBB00DR0	20	#	AMX_IN	60	RW		A0		INT_MSK0	E0	RW
DBB00DR1	21	W	AMUXCFG	61	RW		A1		INT_MSK1	E1	RW
DBB00DR2	22	RW		62			A2		INT_VC	E2	RC
DBB00CR0	23	#	ARF_CR	63	RW		A3		RES_WDT	E3	W
DBB01DR0	24	#	CMP_CR0	64	#		A4		DEC_DH	E4	RC
DBB01DR1	25	W	ASY_CR	65	#		A5		DEC_DL	E5	RC
DBB01DR2	26	RW	CMP_CR1	66	RW		A6		DEC_CR0	E6	RW
DBB01CR0	27	#		67			A7		DEC_CR1	E7	RW
DCB02DR0	28	#		68		MUL1_X	A8	W	MUL0_X	E8	W
DCB02DR1	29	W		69		MUL1_Y	A9	W	MUL0_Y	E9	W
DCB02DR2	2A	RW		6A		MUL1_DH	AA	R	MUL0_DH	EA	R
DCB02CR0	2B	#		6B		MUL1_DL	AB	R	MUL0_DL	EB	R
DCB03DR0	2C	#	TMP_DR0	6C	RW	ACC1_DR1	AC	RW	ACC0_DR1	EC	RW
DCB03DR1	2D	W	TMP_DR1	6D	RW	ACC1_DR0	AD	RW	ACC0_DR0	ED	RW
DCB03DR2	2E	RW	TMP_DR2	6E	RW	ACC1_DR3	AE	RW	ACC0_DR3	EE	RW
DCB03CR0	2F	#	TMP_DR3	6F	RW	ACC1_DR2	AF	RW	ACC0_DR2	EF	RW
	30		ACB00CR3	70	RW	RDI0RI	B0	RW		F0	
	31		ACB00CR0	71	RW	RDI0SYN	B1	RW		F1	
	32		ACB00CR1	72	RW	RDI0IS	B2	RW		F2	
	33		ACB00CR2	73	RW	RDI0LT0	B3	RW		F3	
	34		ACB01CR3	74	RW	RDI0LT1	B4	RW		F4	
	35		ACB01CR0	75	RW	RDI0RO0	B5	RW		F5	
	36		ACB01CR1	76	RW	RDI0RO1	B6	RW		F6	
	37		ACB01CR2	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		DAC_D	FD	RW
	3E			7E			BE		CPU_SCR1	FE	#
	3F			7F			BF		CPU_SCR0	FF	#

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

9.4 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	PMA0_WA	40	RW	ASC10CR0	80	RW	USBI/O_CR2	C0	RW
PRT0DM1	01	RW	PMA1_WA	41	RW	ASC10CR1	81	RW	USB_CR1	C1	#
PRT0IC0	02	RW	PMA2_WA	42	RW	ASC10CR2	82	RW			
PRT0IC1	03	RW	PMA3_WA	43	RW	ASC10CR3	83	RW			
PRT1DM0	04	RW	PMA4_WA	44	RW	ASD11CR0	84	RW	EP1_CR0	C4	#
PRT1DM1	05	RW	PMA5_WA	45	RW	ASD11CR1	85	RW	EP2_CR0	C5	#
PRT1IC0	06	RW	PMA6_WA	46	RW	ASD11CR2	86	RW	EP3_CR0	C6	#
PRT1IC1	07	RW	PMA7_WA	47	RW	ASD11CR3	87	RW	EP4_CR0	C7	#
PRT2DM0	08	RW		48			88			C8	
PRT2DM1	09	RW		49			89			C9	
PRT2IC0	0A	RW		4A			8A			CA	
PRT2IC1	0B	RW		4B			8B			CB	
PRT3DM0	0C	RW		4C			8C			CC	
PRT3DM1	0D	RW		4D			8D			CD	
PRT3IC0	0E	RW		4E			8E			CE	
PRT3IC1	0F	RW		4F			8F			CF	
PRT4DM0	10	RW	PMA0_RA	50	RW		90		GDI_O_IN	D0	RW
PRT4DM1	11	RW	PMA1_RA	51	RW	ASD20CR1	91	RW	GDI_E_IN	D1	RW
PRT4IC0	12	RW	PMA2_RA	52	RW	ASD20CR2	92	RW	GDI_O_OU	D2	RW
PRT4IC1	13	RW	PMA3_RA	53	RW	ASD20CR3	93	RW	GDI_E_OU	D3	RW
PRT5DM0	14	RW	PMA4_RA	54	RW	ASC21CR0	94	RW		D4	
PRT5DM1	15	RW	PMA5_RA	55	RW	ASC21CR1	95	RW		D5	
PRT5IC0	16	RW	PMA6_RA	56	RW	ASC21CR2	96	RW		D6	
PRT5IC1	17	RW	PMA7_RA	57	RW	ASC21CR3	97	RW		D7	
	18			58			98		MUX_CR0	D8	RW
	19			59			99		MUX_CR1	D9	RW
	1A			5A			9A		MUX_CR2	DA	RW
	1B			5B			9B		MUX_CR3	DB	RW
PRT7DM0	1C	RW		5C			9C			DC	
PRT7DM1	1D	RW		5D			9D		OSC_GO_EN	DD	RW
PRT7IC0	1E	RW		5E			9E		OSC_CR4	DE	RW
PRT7IC1	1F	RW		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			E5	
DBB01OU	26	RW	AMD_CR1	66	RW		A6			E6	
	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			6B			AB		ECO_TR	EB	W
DCB03FN	2C	RW	TMP_DR0	6C	RW		AC		MUX_CR4	EC	RW
DCB03IN	2D	RW	TMP_DR1	6D	RW		AD		MUX_CR5	ED	RW
DCB03OU	2E	RW	TMP_DR2	6E	RW		AE			EE	
	2F		TMP_DR3	6F	RW		AF			EF	
	30		ACB00CR3	70	RW	RDI0RI	B0	RW		F0	
	31		ACB00CR0	71	RW	RDI0SYN	B1	RW		F1	
	32		ACB00CR1	72	RW	RDI0IS	B2	RW		F2	
	33		ACB00CR2	73	RW	RDI0LT0	B3	RW		F3	
	34		ACB01CR3	74	RW	RDI0LT1	B4	RW		F4	
	35		ACB01CR0	75	RW	RDI0RO0	B5	RW		F5	
	36		ACB01CR1	76	RW	RDI0RO1	B6	RW		F6	
	37		ACB01CR2	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		DAC_CR	FD	RW
	3E			7E			BE		CPU_SCR1	FE	#
	3F			7F			BF		CPU_SCR0	FF	#

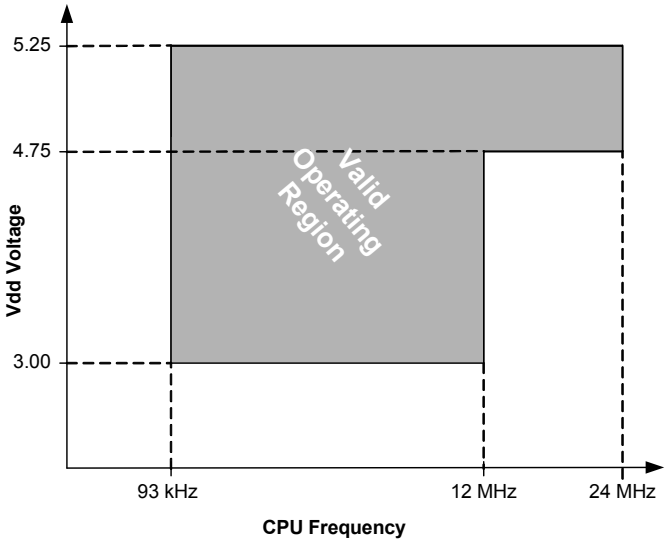
Blank fields are Reserved and should not be accessed. # Access is bit specific.

10. Electrical Specifications

This section presents the DC and AC electrical specifications of the CY8C24x94 PSoC device family. For the most up to date electrical specifications, confirm that you have the most recent data sheet by visiting http://www.cypress.com.

Specifications are valid for –40 °C ≤ T_A ≤ 85 °C and T_J ≤ 100 °C, except where noted. Specifications for devices running at greater than 12 MHz are valid for –40 °C ≤ T_A ≤ 70 °C and T_J ≤ 82 °C.

Figure 10-1. Voltage Versus CPU Frequency



10.1 Absolute Maximum Ratings

Table 10-1. Absolute Maximum Ratings

Symbol	Description	Min	Typ	Max	Units	Notes
T_{STG}	Storage temperature	–55	25	+100	°C	Higher storage temperatures reduces data retention time. Recommended storage temperature is +25 °C ± 25 °C. Extended duration storage temperatures above 65 °C degrades reliability.
$T_{BAKETEMP}$	Bake temperature	–	125	See package label	°C	
$T_{BAKETIME}$	Bake time	See package label	–	72	Hours	
T_A	Ambient temperature with power applied	–40	–	+85	°C	
V_{DD}	Supply voltage on V_{DD} relative to V_{SS}	–0.5	–	+6.0	V	
$V_{I/O}$	DC input voltage	V_{SS} – 0.5	–	V_{DD} + 0.5	V	
$V_{I/O2}$	DC voltage applied to tristate	V_{SS} – 0.5	–	V_{DD} + 0.5	V	
$I_{MI/O}$	Maximum current into any port pin	–25	–	+50	mA	
$I_{MAI/O}$	Maximum current into any port pin configured as analog driver	–50	–	+50	mA	
ESD	Electrostatic discharge voltage	2000	–	–	V	Human body model ESD.
LU	Latch-up current	–	–	200	mA	

10.2 Operating Temperature

Table 10-2. Operating Temperature

Symbol	Description	Min	Typ	Max	Units	Notes
T_A	Ambient temperature	–40	–	+85	°C	
T_{AUSB}	Ambient temperature using USB	–10	–	+85	°C	
T_J	Junction temperature	–40	–	+100	°C	The temperature rise from ambient to junction is package specific. See Thermal Impedance on page 43. The user must limit the power consumption to comply with this requirement.

10.3 DC Electrical Characteristics

10.3.1 DC Chip-Level Specifications

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

Table 10-3. DC Chip-Level Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{DD}	Supply voltage	3.0	–	5.25	V	See DC POR and LVD specifications, Table 10-13 on page 29.
I_{DD5}	Supply current, IMO = 24 MHz (5 V)	–	14	27	mA	Conditions are V_{DD} = 5.0 V, T_A = 25 °C, CPU = 3 MHz, SYSCLK doubler disabled, VC1 = 1.5 MHz, VC2 = 93.75 kHz, VC3 = 93.75 kHz, analog power = off.
I_{DD3}	Supply current, IMO = 24 MHz (3.3 V)	–	8	14	mA	Conditions are V_{DD} = 3.3 V, T_A = 25 °C, CPU = 3 MHz, SYSCLK doubler disabled, VC1 = 1.5 MHz, VC2 = 93.75 kHz, VC3 = 0.367 kHz, analog power = off.
I_{SB}	Sleep (mode) current with POR, LVD, Sleep Timer, and WDT.[12]	–	3	6.5	µA	Conditions are with internal slow speed oscillator, V_{DD} = 3.3 V, –40 °C ≤ T_A ≤ 55 °C, analog power = off.
I_{SBH}	Sleep (mode) current with POR, LVD, Sleep Timer, and WDT at high temperature.[12]	–	4	25	µA	Conditions are with internal slow speed oscillator, V_{DD} = 3.3 V, 55 °C < T_A ≤ 85 °C, analog power = off.

10.3.2 DC General-Purpose I/O Specifications

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

Table 10-4. 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	V_{DD} – 1.0	–	–	V	I_{OH} = 10 mA, V_{DD} = 4.75 to 5.25 V (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 I_{OH} budget.
V_{OL}	Low output level	–	–	0.75	V	I_{OL} = 25 mA, V_{DD} = 4.75 to 5.25 V (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])). 200 mA maximum combined I_{OL} budget.
I_{OH}	High level source current	10	–	–	mA	V_{OH} = V_{DD}-1.0 V, see the limitations of the total current in the note for V_{OH}
I_{OL}	Low level sink current	25	–	–	mA	V_{OL} = 0.75 V, see the limitations of the total current in the note for V_{OL}
V_{IL}	Input low level	–	–	0.8	V	V_{DD} = 3.0 to 5.25.
V_{IH}	Input high level	2.1	–		V	V_{DD} = 3.0 to 5.25.
V_H	Input hysterisis	–	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.

Note
12. Standby current includes all functions (POR, LVD, WDT, Sleep Time) needed for reliable system operation. This should be compared with devices that have similar functions enabled.

10.3.3 DC Full-Speed USB Specifications

The following table lists guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75 V to 5.25 V and –10 °C ≤ T_A ≤ 85 °C, or 3.0 V to 3.6 V and –10 °C ≤ T_A ≤ 85 °C, respectively. Typical parameters apply to 5 V and 3.3 V at 25 °C and are for design guidance only.

Table 10-5. DC Full-Speed (12 Mbps) USB Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
USB Interface						
V_{DI}	Differential input sensitivity	0.2	–	–	V	| (D+) - (D-) |
V_{CM}	Differential input common mode range	0.8	–	2.5	V	
V_{SE}	Single ended receiver threshold	0.8	–	2.0	V	
C_{IN}	Transceiver capacitance	–	–	20	pF	
$I_{I/O}$	High Z state data line leakage	–10	–	10	µA	0 V < V_{IN} < 3.3 V.
R_{EXT}	External USB series resistor	23	–	25	W	In series with each USB pin.
V_{UOH}	Static output high, driven	2.8	–	3.6	V	15 kΩ ± 5% to Ground. Internal pull-up enabled.
V_{UOHI}	Static output high, idle	2.7	–	3.6	V	15 kΩ ± 5% to Ground. Internal pull-up enabled.
V_{UOL}	Static output low	–	–	0.3	V	15 kΩ ± 5% to Ground. Internal pull-up enabled.
Z_O	USB driver output impedance	28	–	44	W	Including R_{EXT} Resistor.
V_{CRS}	D+/D- crossover voltage	1.3	–	2.0	V	

10.3.4 DC Operational Amplifier Specifications

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

The Operational Amplifier is a component of both the Analog Continuous Time PSoC blocks and the Analog Switched Capacitor PSoC blocks. The guaranteed specifications are measured in the Analog Continuous Time PSoC block.

Table 10-6. 5-V DC Operational Amplifier Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{OSOA}	Input offset voltage (absolute value) Power = Low, Opamp Bias = High Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 – – –	 1.6 1.3 1.2	 10 8 7.5	 mV mV mV	
TCV_{OSOA}	Average input offset voltage drift	–	7.0	35.0	µV/°C	
I_{EBOA}	Input leakage current (Port 0 analog pins)	–	20	–	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 Common mode voltage range (high power or high opamp bias)	0.0 0.5	– –	V_{DD} V_{DD} – 0.5	V	The common-mode input voltage range is measured through an analog output buffer. The specification includes the limitations imposed by the characteristics of the analog output buffer.
G_{OLOA}	Open loop gain Power = Low, Opamp Bias = High Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 60 60 80	–	–	dB	

Table 10-6. 5-V DC Operational Amplifier Specifications *(continued)*

Symbol	Description	Min	Typ	Max	Units	Notes
$V_{OHIGHOA}$	High output voltage swing (internal signals) Power = Low, Opamp Bias = High Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 V_{DD} – 0.2 V_{DD} – 0.2 V_{DD} – 0.5	 – – –	 – – –	 V V V	
V_{OLOWOA}	Low output voltage swing (internal signals) Power = Low, Opamp Bias = High Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 – – –	 – – –	 0.2 0.2 0.5	 V V V	
I_{SOA}	Supply current (including associated AGND buffer) Power = Low, Opamp Bias = Low Power = Low, Opamp Bias = High Power = Medium, Opamp Bias = Low Power = Medium, Opamp Bias = High Power = High, Opamp Bias = Low Power = High, Opamp Bias = High	 – – – – – –	 400 500 800 1200 2400 4600	 800 900 1000 1600 3200 6400	 µA µA µA µA µA µA	
$PSRR_{OA}$	Supply voltage rejection ratio	65	80	–	dB	$V_{SS} \le VIN \le (V_{DD} – 2.25)$ or $(V_{DD} – 1.25\ V) \le VIN \le V_{DD}$.

10.3.5 DC Low-Power Comparator Specifications

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

Table 10-7. DC Low-Power Comparator Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{REFLPC}	Low power comparator (LPC) reference voltage range	0.2	–	V_{DD} – 1	V	
I_{SLPC}	LPC supply current	–	10	40	µA	
V_{OSLPC}	LPC voltage offset	–	2.5	30	mV	

10.3.6 DC Analog Output Buffer Specifications

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

Table 10-8. 5-V DC Analog Output Buffer Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{OSOB}	Input offset voltage (absolute value)	–	3	12	mV	
TCV_{OSOB}	Average input offset voltage drift	–	+6	–	µV/°C	
V_{CMOB}	Common mode input voltage range	0.5	–	V_{DD} – 1.0	V	
R_{OUTOB}	Output resistance Power = Low Power = High	 – –	 0.6 0.6	 – –	 W W	
$V_{OHIGHOB}$	High output voltage swing (Load = 32 ohms to $V_{DD}/2$) Power = Low Power = High	 0.5 × V_{DD} + 1.1 0.5 × V_{DD} + 1.1	 – –	 – –	 V V	
V_{OLOWOB}	Low output voltage swing (Load = 32 ohms to $V_{DD/2}$) Power = Low Power = High	 – –	 – –	 0.5 × V_{DD} – 1.3 0.5 × V_{DD} – 1.3	 V V	
I_{SOB}	Supply current including bias cell (No Load) Power = Low Power = High	 – –	 1.1 2.6	 5.1 8.8	 mA mA	
$PSRR_{OB}$	Supply voltage rejection ratio	53	64	–	dB	(0.5 x V_{DD} – 1.3) ≤ V_{OUT} ≤ (V_{DD} – 2.3).

Table 10-9. 3.3-V DC Analog Output Buffer Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
V_{OSOB}	Input offset voltage (absolute value)	–	3	12	mV	
TCV_{OSOB}	Average input offset voltage drift	–	+6	–	µV/°C	
V_{CMOB}	Common mode input voltage range	0.5	-	V_{DD} – 1.0	V	
R_{OUTOB}	Output resistance Power = Low Power = High	 – –	 1 1	 – –	 W W	
$V_{OHIGHOB}$	High output voltage swing (Load = 1K ohms to $V_{DD/2}$) Power = Low Power = High	 0.5 × V_{DD} + 1.0 0.5 × V_{DD} + 1.0	 – –	 – –	 V V	
V_{OLOWOB}	Low output voltage swing (Load = 1K ohms to Vdd/2) Power = Low Power = High	 – –	 – –	 0.5 × V_{DD} – 1.0 0.5 × V_{DD} – 1.0	 V V	
I_{SOB}	Supply current including bias cell (No Load) Power = Low Power = High	 –	 0.8 2.0	 2.0 4.3	 mA mA	
$PSRR_{OB}$	Supply voltage rejection ratio	34	64	–	dB	(0.5 x V_{DD} – 1.0) ≤ V_{OUT} ≤ (0.5 × V_{DD} + 0.9).

10.3.7 DC Analog Reference Specifications

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

The guaranteed specifications are measured through the analog continuous time PSoC blocks. The power levels for AGND refer to the power of the Analog Continuous Time PSoC block. The power levels for RefHi and RefLo refer to the Analog Reference Control register. The limits stated for AGND include the offset error of the AGND buffer local to the Analog Continuous Time PSoC block. Reference control power is high.

Table 10-10. 5 V DC Analog Reference Specifications

Symbol	Description	Min	Typ	Max	Units
BG	Bandgap voltage reference	1.28	1.30	1.32	V
–	AGND = $V_{DD/2}$[13, 14]	$V_{DD/2}$ – 0.04	$V_{DD/2}$ – 0.01	$V_{DD/2}$ + 0.007	V
–	AGND = 2 x BandGap[13, 14]	2 × BG – 0.048	2 × BG - 0.030	2 × BG + 0.024	V
–	AGND = P2[4] (P2[4] = $V_{DD/2}$)[13, 14]	P2[4] – 0.011	P2[4]	P2[4] + 0.011	V
–	AGND = BandGap[13, 14]	BG – 0.009	BG + 0.008	BG + 0.016	V
–	AGND = 1.6 x BandGap[13, 14]	1.6 × BG – 0.022	1.6 × BG – 0.010	1.6 × BG + 0.018	V
–	AGND block to block variation (AGND = $V_{DD/2}$)[13, 14]	–0.034	0.000	0.034	V
–	RefHi = $V_{DD/2}$ + BandGap	$V_{DD/2}$ + BG – 0.10	$V_{DD/2}$ + BG	$V_{DD/2}$ + BG + 0.10	V
–	RefHi = 3 x BandGap	3 x BG – 0.06	3 x BG	3 x BG + 0.06	V
–	RefHi = 2 x BandGap + P2[6] (P2[6] = 1.3 V)	2 × BG + P2[6] – 0.113	2 × BG + P2[6] - 0.018	2 × BG + P2[6] + 0.077	V
–	RefHi = P2[4] + BandGap (P2[4] = $V_{DD/2}$)	P2[4] + BG – 0.130	P2[4] + BG - 0.016	P2[4] + BG + 0.098	V
–	RefHi = P2[4] + P2[6] (P2[4] = $V_{DD/2}$, P2[6] = 1.3 V)	P2[4] + P2[6] – 0.133	P2[4] + P2[6] - 0.016	P2[4] + P2[6]+ 0.100	V
–	RefHi = 3.2 x BandGap	3.2 × BG – 0.112	3.2 x BG	3.2 × BG + 0.076	V
–	RefLo = $V_{DD/2}$ – BandGap	$V_{DD/2}$ – BG – 0.04	$V_{DD/2}$ - BG + 0.024	$V_{DD/2}$ – BG + 0.04	V
–	RefLo = BandGap	BG – 0.06	BG	BG + 0.06	V
–	RefLo = 2 x BandGap - P2[6] (P2[6] = 1.3 V)	2 × BG – P2[6] – 0.084	2 × BG - P2[6] + 0.025	2 × BG – P2[6] + 0.134	V
–	RefLo = P2[4] – BandGap (P2[4] = $V_{DD/2}$)	P2[4] – BG – 0.056	P2[4] – BG + 0.026	P2[4] - BG + 0.107	V
–	RefLo = P2[4]-P2[6] (P2[4] = $V_{DD/2}$, P2[6] = 1.3 V)	P2[4] – P2[6] – 0.057	P2[4] – P2[6] + 0.026	P2[4] – P2[6] + 0.110	V

Table 10-11. 3.3-V DC Analog Reference Specifications

Symbol	Description	Min	Typ	Max	Units
BG	Bandgap voltage reference	1.28	1.30	1.32	V
–	AGND = $V_{DD/2}$[13, 14]	$V_{DD/2}$ – 0.03	$V_{DD/2}$ – 0.01	$V_{DD/2}$ + 0.005	V
–	AGND = 2 x BandGap[13, 14]	Not Allowed			
–	AGND = P2[4] (P2[4] = $V_{DD/2}$)	P2[4] – 0.008	P2[4] + 0.001	P2[4] + 0.009	V
–	AGND = BandGap[13, 14]	BG – 0.009	BG + 0.005	BG + 0.015	V
–	AGND = 1.6 x BandGap[13, 14]	1.6 x BG – 0.027	1.6 x BG – 0.010	1.6 x BG + 0.018	V
–	AGND column to column variation (AGND = $V_{DD/2}$)[13, 14]	–0.034	0.000	0.034	V
–	RefHi = $V_{DD/2}$ + BandGap	Not Allowed			
–	RefHi = 3 x BandGap	Not Allowed			
–	RefHi = 2 x BandGap + P2[6] (P2[6] = 0.5 V)	Not Allowed			
–	RefHi = P2[4] + BandGap (P2[4] = $V_{DD/2}$)	Not Allowed			
–	RefHi = P2[4] + P2[6] (P2[4] = $V_{DD/2}$, P2[6] = 0.5 V)	P2[4] + P2[6] – 0.075	P2[4] + P2[6] – 0.009	P2[4] + P2[6] + 0.057	V
–	RefHi = 3.2 x BandGap	Not Allowed			
–	RefLo = $V_{DD/2}$ - BandGap	Not Allowed			
–	RefLo = BandGap	Not Allowed			
–	RefLo = 2 x BandGap - P2[6] (P2[6] = 0.5 V)	Not Allowed			
–	RefLo = P2[4] – BandGap (P2[4] = $V_{DD/2}$)	Not Allowed			
–	RefLo = P2[4]-P2[6] (P2[4] = $V_{DD/2}$, P2[6] = 0.5 V)	P2[4] – P2[6] – 0.048	P2[4] – P2[6] + 0.022	P2[4] – P2[6] + 0.092	V

10.3.8 DC Analog PSoC Block Specifications

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

Table 10-12. DC Analog PSoC Block Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
R_{CT}	Resistor unit value (continuous time)	–	12.2	–	kΩ	
C_{SC}	Capacitor unit value (switched capacitor)	–	80	–	fF	

Note
13. AGND tolerance includes the offsets of the local buffer in the PSoC block. Bandgap voltage is 1.3 V ± 0.02 V.
14. Avoid using P2[4] for digital signaling when using an analog resource that depends on the Analog Reference. Some coupling of the digital signal may appear on the AGND.

10.3.9 DC POR and LVD Specifications

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

Note The bits PORLEV and VM in the following table refer to bits in the VLT_CR register. See the *PSoC Technical Reference Manual* for more information on the VLT_CR register.

Table 10-13. DC POR and LVD Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
	V_{DD} value for PPOR trip (positive ramp)					
V_{PPOR0R}	PORLEV[1:0] = 00b		2.91		V	
V_{PPOR1R}	PORLEV[1:0] = 01b	–	4.39	–	V	
V_{PPOR2R}	PORLEV[1:0] = 10b		4.55		V	
	V_{DD} value for PPOR trip (negative ramp)					
V_{PPOR0}	PORLEV[1:0] = 00b		2.82		V	
V_{PPOR1}	PORLEV[1:0] = 01b	–	4.39	–	V	
V_{PPOR2}	PORLEV[1:0] = 10b		4.55		V	
	PPOR hysteresis					
V_{PH0}	PORLEV[1:0] = 00b	–	92	–	mV	
V_{PH1}	PORLEV[1:0] = 01b	–	0	–	mV	
V_{PH2}	PORLEV[1:0] = 10b	–	0	–	mV	
	V_{DD} value for LVD trip					
V_{LVD0}	VM[2:0] = 000b	2.86	2.92	2.98[15]	V	
V_{LVD1}	VM[2:0] = 001b	2.96	3.02	3.08	V	
V_{LVD2}	VM[2:0] = 010b	3.07	3.13	3.20	V	
V_{LVD3}	VM[2:0] = 011b	3.92	4.00	4.08	V	
V_{LVD4}	VM[2:0] = 100b	4.39	4.48	4.57	V	
V_{LVD5}	VM[2:0] = 101b	4.55	4.64	4.74[16]	V	
V_{LVD6}	VM[2:0] = 110b	4.63	4.73	4.82	V	
V_{LVD7}	VM[2:0] = 111b	4.72	4.81	4.91	V	

Notes
15. Always greater than 50 mV above PPOR (PORLEV = 00) for falling supply.
16. Always greater than 50 mV above PPOR (PORLEV = 10) for falling supply.

10.3.10 DC Programming Specifications

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

Table 10-14. DC Programming Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
I_{DDP}	Supply current during programming or verify	–	15	30	mA	
V_{ILP}	Input low voltage during programming or verify	–	–	0.8	V	
V_{IHP}	Input high voltage during programming or verify	2.1	–	–	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	–	–	V_{SS} + 0.75	V	
V_{OHV}	Output high voltage during programming or verify	V_{DD} – 1.0	–	V_{DD}	V	
$Flash_{ENPB}$	Flash endurance (per block)[17]	50,000	–	–	–	Erase/write cycles per block.
$Flash_{ENT}$	Flash endurance (total)[18]	1,800,000	–	–	–	Erase/write cycles.
$Flash_{DR}$	Flash data retention	10	–	–	Years	

Notes

17. The 50,000 cycle flash endurance per block will only be guaranteed if the flash is operating within one voltage range. Voltage ranges are 3.0 V to 3.6 V and 4.75 V to 5.25 V.
18. 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 (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.

10.4 AC Electrical Characteristics

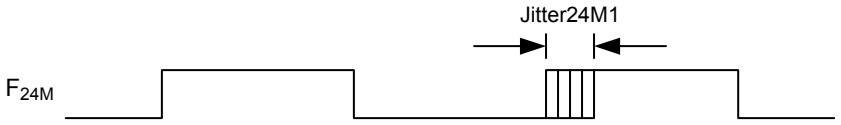
10.4.1 AC Chip-Level Specifications

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

Table 10-15. AC Chip-Level Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
$F_{IMO245V}$	Internal main oscillator frequency for 24 MHz (5 V)	23.04	24	24.96[19,20]	MHz	Trimmed for 5 V operation using factory trim values.
$F_{IMO243V}$	Internal main oscillator frequency for 24 MHz (3.3 V)	22.08	24	25.92[20,21]	MHz	Trimmed for 3.3 V operation using factory trim values.
$F_{IMOUSB5V}$	Internal main oscillator frequency with USB (5 V) Frequency locking enabled and USB traffic present.	23.94	24	24.06[20]	MHz	–10 °C ≤ T_A ≤ 85 °C 4.35 ≤ V_{DD} ≤ 5.15
$F_{IMOUSB3V}$	Internal main oscillator frequency with USB (3.3 V) Frequency locking enabled and USB traffic present.	23.94	24	24.06[20]	MHz	–0 °C ≤ T_A ≤ 70 °C 3.15 ≤ V_{DD} ≤ 3.45
F_{IMO6}	Internal main oscillator frequency for 6 MHz	5.5	6	6.5[19,20,21]	MHz	Trimmed for 5 V or 3.3 V operation using factory trim values. See the figure on page 19. SLIMO Mode = 1.
F_{CPU1}	CPU frequency (5 V nominal)	0.090	24	24.96[19,20]	MHz	
F_{CPU2}	CPU frequency (3.3 V nominal)	0.086	12	12.96[20,21]	MHz	
F_{BLK5}	Digital PSoC block frequency (5 V nominal)	0	48	49.92[19,20,22]	MHz	Refer to the AC digital block Specifications.
F_{BLK3}	Digital PSoC block frequency (3.3 V nominal)	0	24	25.92[20,22]	MHz	
F_{32K1}	Internal low speed oscillator frequency	15	32	64	kHz	
F_{32K_U}	Internal low speed oscillator untrimmed frequency	5	–	–	kHz	After a reset and before the m8c starts to run, the ILO is not trimmed. See the System Resets section of the PSoC Technical Reference Manual for details on timing this
Jitter32k	32 kHz period jitter	–	100		ns	
T_{XRST}	External reset pulse width	10	–	–	µs	
DC24M	24 MHz duty cycle	40	50	60	%	
DC_{ILO}	Internal low speed oscillator duty cycle	20	50	80	%	
Step24M	24 MHz trim step size	–	50	–	kHz	
Fout48M	48 MHz output frequency	46.08	48.0	49.92[19,21]	MHz	Trimmed. Utilizing factory trim values.
Jitter24M1	24 MHz period jitter (IMO) peak-to-peak	–	300		ps	
F_{MAX}	Maximum frequency of signal on row input or row output.	–	–	12.96	MHz	
SR_{POWER_UP}	Power supply slew rate	–	–	250	V/ms	V_{DD} slew rate during power up.
$T_{POWERUP}$	Time from end of POR to CPU executing code	–	16	100	ms	Power up from 0 V. See the System Resets section of the PSoC Technical Reference Manual.

Figure 10-2. 24 MHz Period Jitter (IMO) Timing Diagram



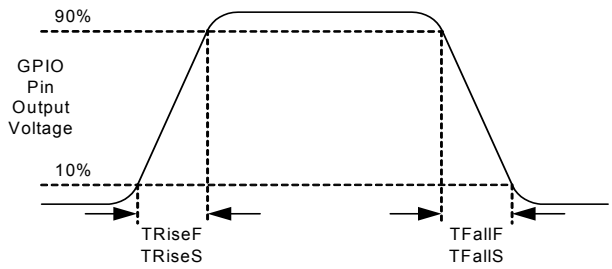
10.4.2 AC General-Purpose I/O Specifications

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

Table 10-16. 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	V_{DD} = 4.5 to 5.25 V, 10% - 90%
TFallF	Fall time, normal strong mode, Cload = 50 pF	2	–	18	ns	V_{DD} = 4.5 to 5.25 V, 10% - 90%
TRiseS	Rise time, slow strong mode, Cload = 50 pF	10	27	–	ns	V_{DD} = 3 to 5.25 V, 10% - 90%
TFallS	Fall time, slow strong mode, Cload = 50 pF	10	22	–	ns	V_{DD} = 3 to 5.25 V, 10% - 90%

Figure 10-3. GPIO Timing Diagram



10.4.3 AC Full-Speed USB Specifications

The following table lists guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75 V to 5.25 V and –10 °C ≤ T_A ≤ 85 °C, or 3.0 V to 3.6 V and –10 °C ≤ T_A ≤ 85 °C, respectively. Typical parameters apply to 5 V and 3.3 V at 25 °C and are for design guidance only.

Table 10-17. AC Full-Speed (12 Mbps) USB Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
T_{RFS}	Transition rise time	4	–	20	ns	For 50 pF load.
T_{FSS}	Transition fall time	4	–	20	ns	For 50 pF load.
T_{RFMFS}	Rise/fall time matching: (T_R/T_F)	90	–	111	%	For 50 pF load.
$T_{DRATEFS}$	Full-speed data rate	12 – 0.25%	12	12 + 0.25%	Mbps	

Notes
19. 4.75 V < V_{DD} < 5.25 V.
20. Accuracy derived from Internal Main Oscillator with appropriate trim for V_{DD} range.
21. 3.0 V < V_{DD} < 3.6 V. See Application Note AN2012 “Adjusting PSoC Microcontroller Trims for Dual Voltage-Range Operation” for information on trimming for operation at 3.3 V.
22. See the individual user module data sheets for information on maximum frequencies for user modules

10.4.4 AC Operational Amplifier Specifications

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

Power = High and Opamp Bias = High is not supported at 3.3 V.

Table 10-18. 5-V AC Operational Amplifier Specifications

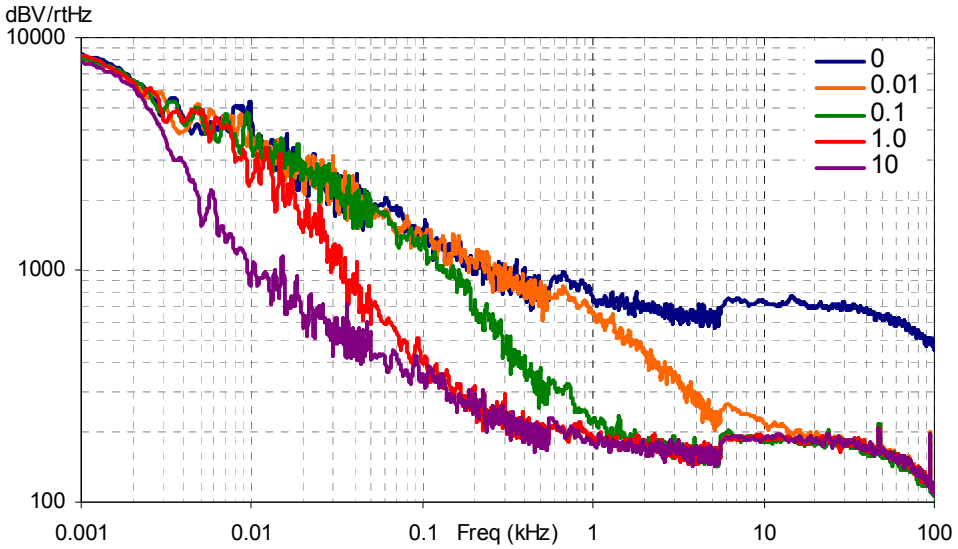
Symbol	Description	Min	Typ	Max	Units
T_{ROA}	Rising settling time from 80% of ΔV to 0.1% of ΔV (10 pF load, unity gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 – – –	 – – –	 3.9 0.72 0.62	 µs µs µs
T_{SOA}	Falling settling time from 20% of ΔV to 0.1% of ΔV (10 pF load, unity gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 – – –	 – – –	 5.9 0.92 0.72	 µs µs µs
SR_{ROA}	Rising slew rate (20% to 80%)(10 pF load, unity gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 0.15 1.7 6.5	 – – –	 – – –	 V/µs V/µs V/µs
SR_{FOA}	Falling slew rate (20% to 80%)(10 pF load, unity gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 0.01 0.5 4.0	 – – –	 – – –	 V/µs V/µs V/µs
BW_{OA}	Gain bandwidth product Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High Power = High, Opamp Bias = High	 0.75 3.1 5.4	 – – –	 – – –	 MHz MHz MHz
E_{NOA}	Noise at 1 kHz (Power = Medium, Opamp Bias = High)	–	100	–	nV/rt-Hz

Table 10-19. 3.3-V AC Operational Amplifier Specifications

Symbol	Description	Min	Typ	Max	Units
T_{ROA}	Rising settling time from 80% of ΔV to 0.1% of ΔV (10 pF load, unity gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High	 – –	 – –	 3.92 0.72	 µs µs
T_{SOA}	Falling settling time from 20% of ΔV to 0.1% of ΔV (10 pF load, unity gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High	 – –	 – –	 5.41 0.72	 µs µs
SR_{ROA}	Rising slew rate (20% to 80%)(10 pF load, unity gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High	 0.31 2.7	 – –	 – –	 V/µs V/µs
SR_{FOA}	Falling Slew Rate (20% to 80%)(10 pF load, Unity Gain) Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High	0.24 1.8	– –	– –	V/µs V/µs
BW_{OA}	Gain bandwidth product Power = Low, Opamp Bias = Low Power = Medium, Opamp Bias = High	 0.67 2.8	 – –	 – –	 MHz MHz
E_{NOA}	Noise at 1 kHz (Power = Medium, Opamp Bias = High)	–	100	–	nV/rt-Hz

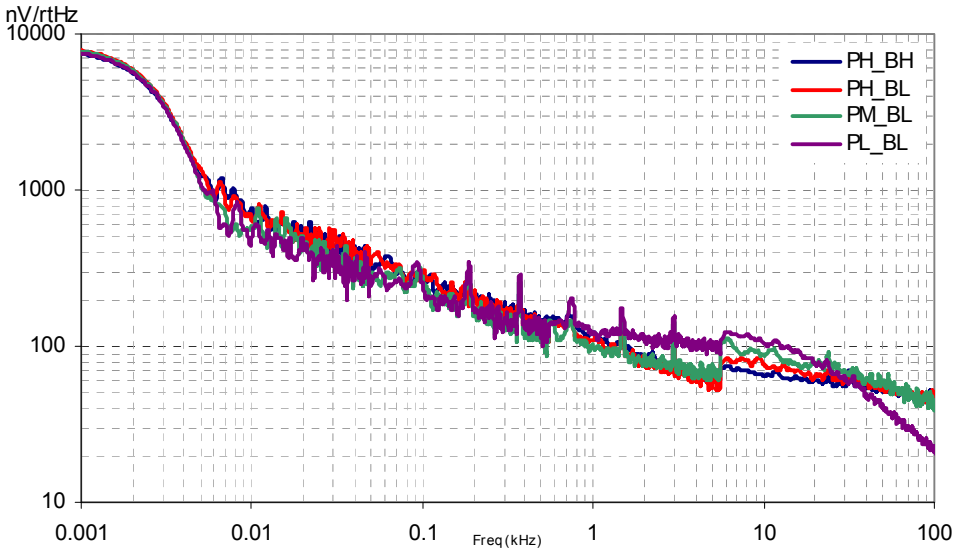
When bypassed by a capacitor on P2[4], the noise of the analog ground signal distributed to each block is reduced by a factor of up to 5 (14 dB). This is at frequencies above the corner frequency defined by the on-chip 8.1k resistance and the external capacitor.

Figure 10-4. Typical AGND Noise with P2[4] Bypass



At low frequencies, the opamp noise is proportional to 1/f, power independent, and determined by device geometry. At high frequencies, increased power level reduces the noise spectrum level.

Figure 10-5. Typical Opamp Noise



10.4.5 AC Low-Power Comparator Specifications

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

Table 10-20. AC Low Power Comparator Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
T_{RLPC}	LPC response time	–	–	50	µs	≥ 50 mV overdrive comparator reference set within V_{REFLPC}.

10.4.6 AC Digital Block Specifications

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

Table 10-21. AC Digital Block Specifications

Function	Description	Min	Typ	Max	Units	Notes
Timer	Capture pulse width	50[23]	–	–	ns	
	Maximum frequency, no capture	–	–	49.92	MHz	4.75 V < V_{DD} < 5.25 V.
	Maximum frequency, with capture	–	–	25.92	MHz	
Counter	Enable pulse width	50[23]	–	–	ns	
	Maximum frequency, no enable input	–	–	49.92	MHz	4.75 V < V_{DD} < 5.25 V.
	Maximum frequency, enable input	–	–	25.92	MHz	
Dead Band	Kill pulse width:					
	Asynchronous restart mode	20	–	–	ns	
	Synchronous restart mode	50[23]	–	–	ns	
	Disable mode	50[23]	–	–	ns	
	Maximum frequency	–	–	49.92	MHz	4.75 V < V_{DD} < 5.25 V.
CRCPRS (PRS Mode)	Maximum input clock frequency	–	–	49.92	MHz	4.75 V < V_{DD} < 5.25 V.
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 × overclocking.
SPIS	Maximum input clock frequency	–	–	4.1	MHz	
	Width of SS_ negated between transmissions	50[23]	–	–	ns	
Transmitter	Maximum input clock frequency	–	–	24.6	MHz	Maximum data rate at 3.08 MHz due to 8 × overclocking.
Receiver	Maximum input clock frequency	–	–	24.6	MHz	Maximum data rate at 3.08 MHz due to 8 × overclocking.

Note
23. 50 ns minimum input pulse width is based on the input synchronizers running at 24 MHz (42 ns nominal period).

10.4.7 AC External Clock Specifications

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

Table 10-22. AC External Clock Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
F_{OSCEXT}	Frequency for USB applications	23.94	24	24.06	MHz	
–	Duty cycle	47	50	53	%	
–	Power up to IMO switch	150	–	–	µs	

10.4.8 AC Analog Output Buffer Specifications

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

Table 10-23. 5-V AC Analog Output Buffer Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
T_{ROB}	Rising settling time to 0.1%, 1 V Step, 100 pF Load Power = Low Power = High	 – –	 – –	 2.5 2.5	 µs µs	
T_{SOB}	Falling settling time to 0.1%, 1 V Step, 100 pF Load Power = Low Power = High	 – –	 – –	 2.2 2.2	 µs µs	
SR_{ROB}	Rising slew rate (20% to 80%), 1 V Step, 100 pF Load Power = Low Power = High	 0.65 0.65	 – –	 – –	 V/µs V/µs	
SR_{FOB}	Falling slew rate (80% to 20%), 1 V Step, 100 pF Load Power = Low Power = High	 0.65 0.65	 – –	 – –	 V/µs V/µs	
BW_{OBSS}	Small signal bandwidth, 20mV_{pp}, 3dB BW, 100 pF Load Power = Low Power = High	 0.8 0.8	 – –	 – –	 MHz MHz	
BW_{OBLS}	Large signal bandwidth, 1V_{pp}, 3dB BW, 100 pF Load Power = Low Power = High	 300 300	 – –	 – –	 kHz kHz	

Table 10-24. 3.3-V AC Analog Output Buffer Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
T_{ROB}	Rising settling time to 0.1%, 1 V Step, 100 pF Load Power = Low Power = High	 – –	 – –	 3.8 3.8	 µs µs	
T_{SOB}	Falling settling time to 0.1%, 1 V Step, 100 pF Load Power = Low Power = High	 – –	 – –	 2.6 2.6	 µs µs	
SR_{ROB}	Rising slew rate (20% to 80%), 1 V Step, 100 pF Load Power = Low Power = High	 0.5 0.5	 – –	 – –	 V/µs V/µs	
SR_{FOB}	Falling slew rate (80% to 20%), 1 V Step, 100 pF Load Power = Low Power = High	 0.5 0.5	 – –	 – –	 V/µs V/µs	
BW_{OBSS}	Small signal bandwidth, 20mV_{pp}, 3dB BW, 100 pF Load Power = Low Power = High	 0.7 0.7	 – –	 – –	 MHz MHz	
BW_{OBLS}	Large signal bandwidth, 1V_{pp}, 3dB BW, 100 pF Load Power = Low Power = High	 200 200	 – –	 – –	 kHz kHz	

10.4.9 AC Programming Specifications

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

Table 10-25. 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 setup 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)	–	10	–	ms	
T_{WRITE}	Flash block write time	–	40	–	ms	
T_{DSCLK}	Data out delay from falling edge of SCLK	–	–	45	ns	V_{DD} > 3.6
T_{DSCLK3}	Data out delay from falling edge of SCLK	–	–	50	ns	3.0 ≤ V_{DD} ≤ 3.6
$T_{ERASEALL}$	Flash erase time (Bulk)	–	40	–	ms	Erase all blocks and protection fields at once
$T_{PROGRAM\_HOT}$	Flash block erase + Flash block write time	–	–	100[24]	ms	0°C ≤ Tj ≤ 100 °C
$T_{PROGRAM\_COLD}$	Flash block erase + Flash block write time	–	–	200[24]	ms	–40°C ≤ Tj ≤ 0 °C

Note
24. 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.

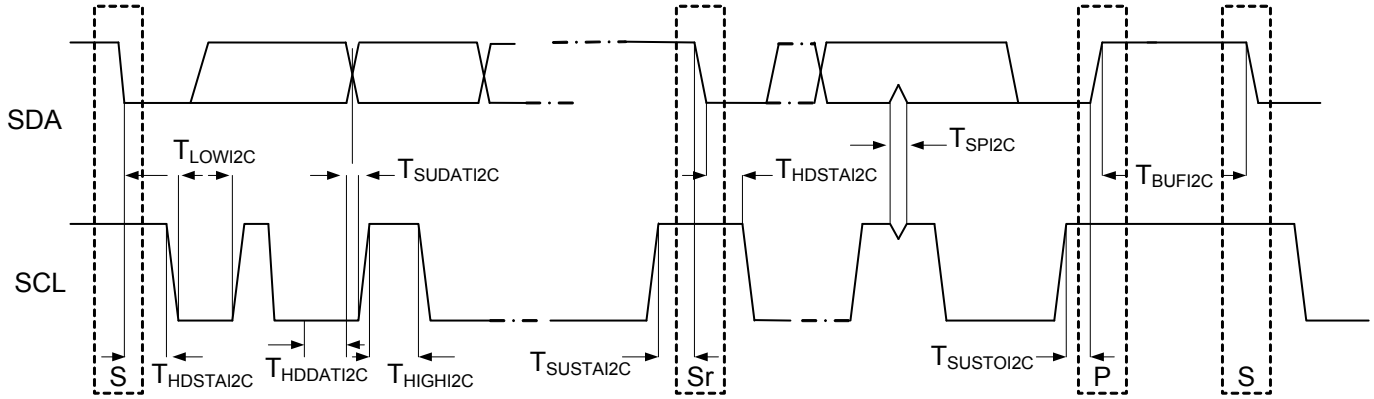
10.4.10 AC I²C Specifications

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

Table 10-26. AC Characteristics of the I²C SDA and SCL Pins for V_{DD}

Symbol	Description	Standard Mode		Fast Mode		Units	Notes
		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[25]	–	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	

Figure 10-6. Definition for Timing for Fast/Standard Mode on the I²C Bus



Note

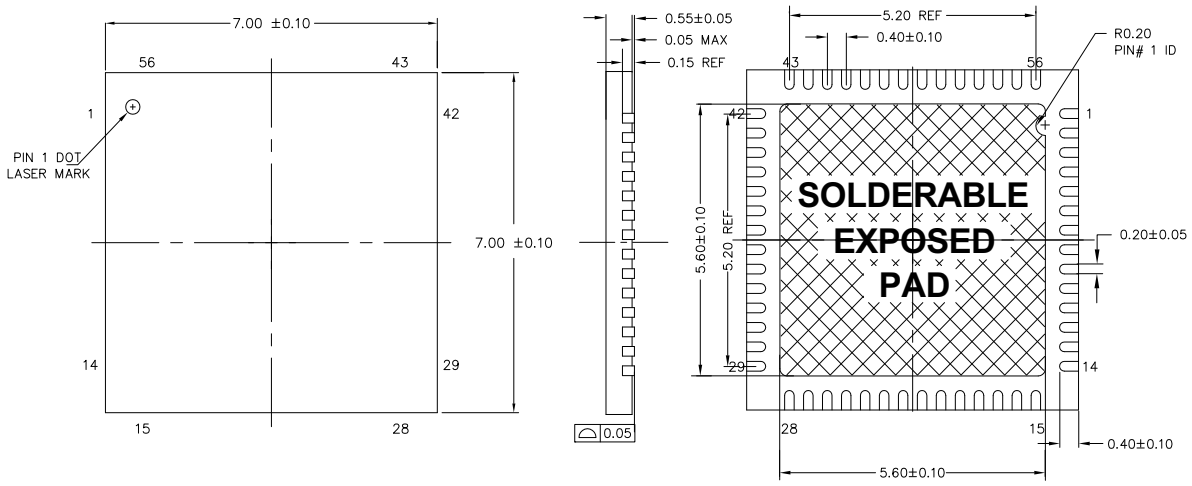
25. A Fast-Mode I2C-bus device can be used in a Standard-Mode I2C-bus system, but the requirement $t_{SU;DAT}$ Š 250 ns must then be met. This automatically is the case if the device does not stretch the LOW period of the SCL signal. If such device does stretch the LOW period of the SCL signal, it must 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.

11. Packaging Dimensions

This section illustrates the package specification for the CY8C24x94 PSoC devices, along with the thermal impedance for the package and solder reflow peak temperatures.

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 emulator pod dimension drawings at http://www.cypress.com/design/MR10161.

Figure 11-1. 56-Pin (7x7x0.6 mm) QFN

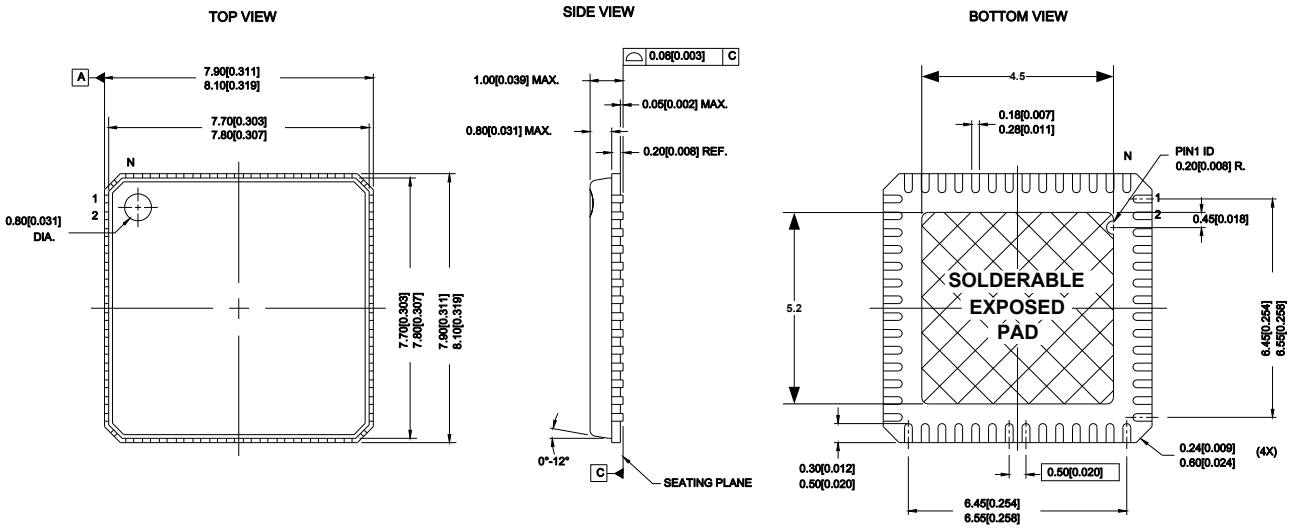


NOTES:

1. HATCH AREA IS SOLDERABLE EXPOSED PAD
2. BASED ON REF JEDEC # MO-220
3. PACKAGE WEIGHT: 0.0928 grams
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-58740 **

Figure 11-2. 56-Pin (8x8 mm) QFN



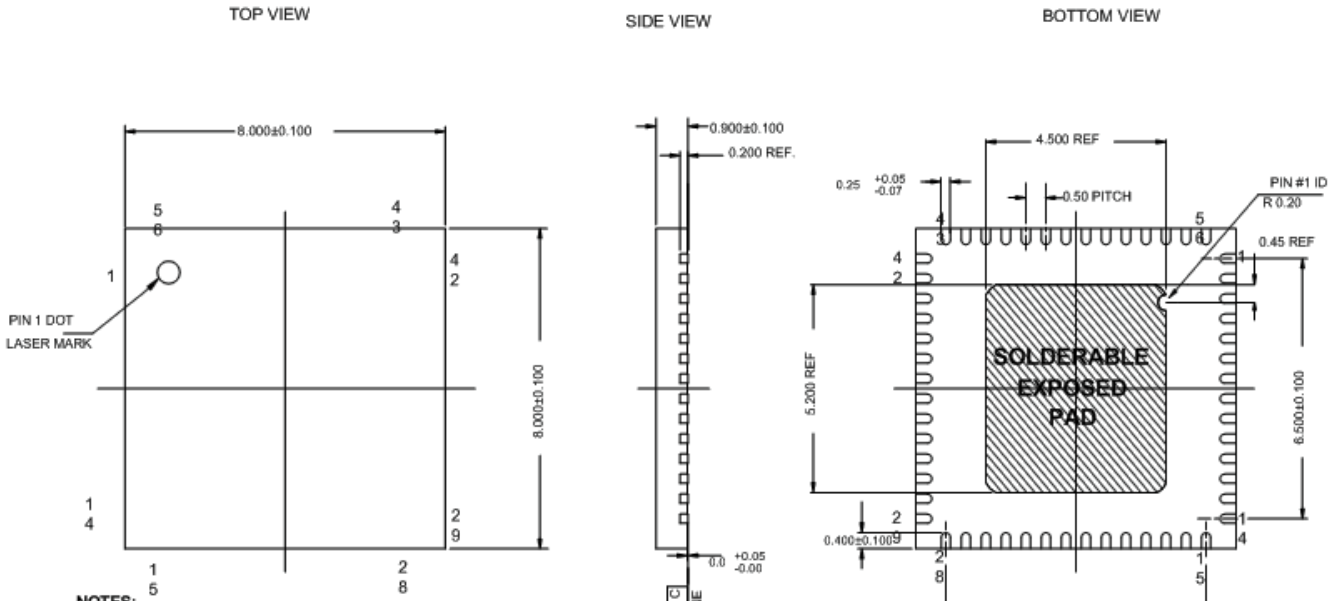
NOTES:

1. HATCH AREA IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.162g
4. ALL DIMENSIONS ARE IN MM [MIN/MAX]
5. PACKAGE CODE

PART #	DESCRIPTION
LF56A	STANDARD
LY56A	PB-FREE

001-12921 *A

Figure 11-3. 56-Pin QFN (8 X 8 X 0.9 MM) - Sawn

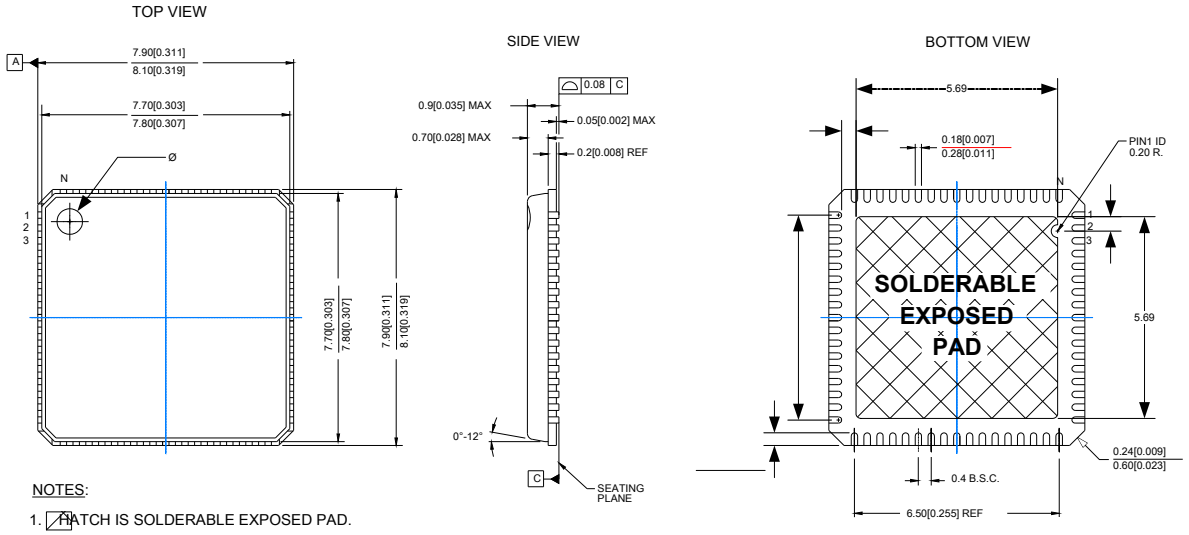


NOTES:

1. HATCH AREA IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.162G
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-53450 *B

Figure 11-4. 68-Pin (8x8 mm x 0.89 mm) QFN



NOTES:

1. HATCH IS SOLDERABLE EXPOSED PAD.
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.17g
4. ALL DIMENSIONS ARE IN MM [MIN/MAX]
5. PACKAGE CODE

PART #	DESCRIPTION
LF68	STANDARD
LY68	PB-FREE

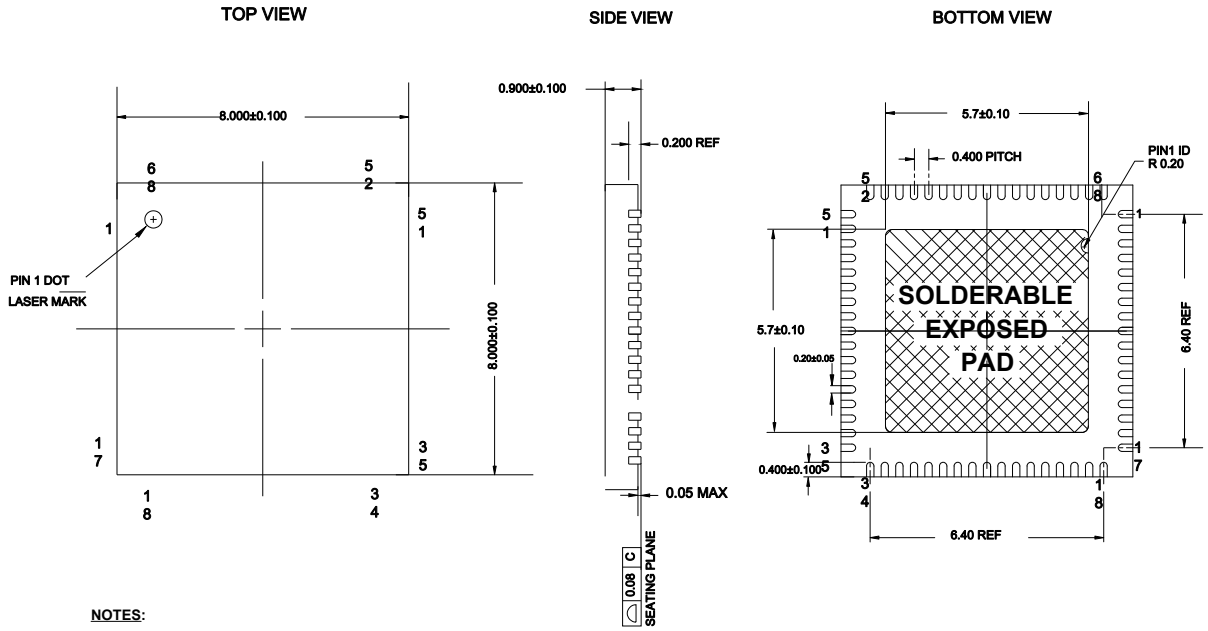
NOTE: EXPOSED PAD DIMENSION VARIES BY LEADFRAME CAVITY (PADDLE) SIZE

51-85214 *D

Important Note

- For information on the preferred dimensions for mounting QFN packages, refer to Application Note, "Application Notes for Surface Mount Assembly of Amkor's MicroLeadFrame (MLF) Packages" available at http://www.amkor.com.
- Pinned vias for thermal conduction are not required for the low-power PSoC device.

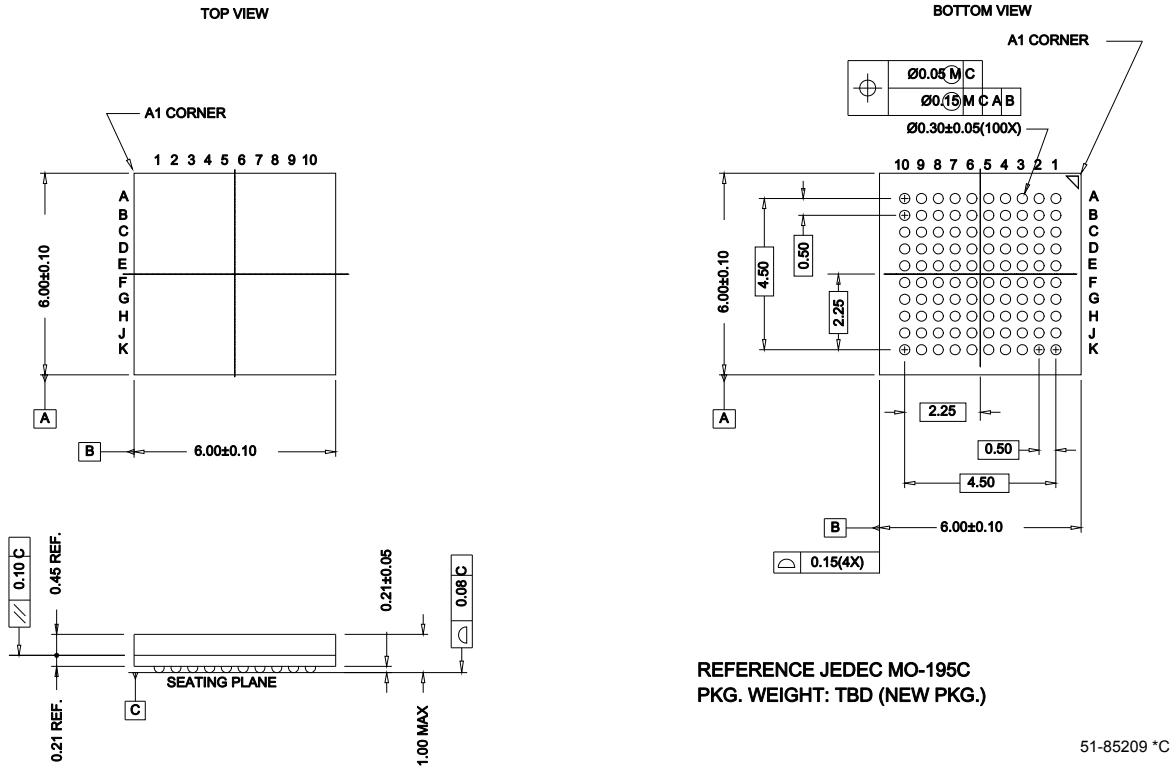
Figure 11-5. 68-Pin Sawn QFN (8X8 mm X 0.90 mm)



NOTES:
1. HATCH AREA IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.17g
ALL DIMENSIONS ARE IN MILLIMETERS

001-09618 *C

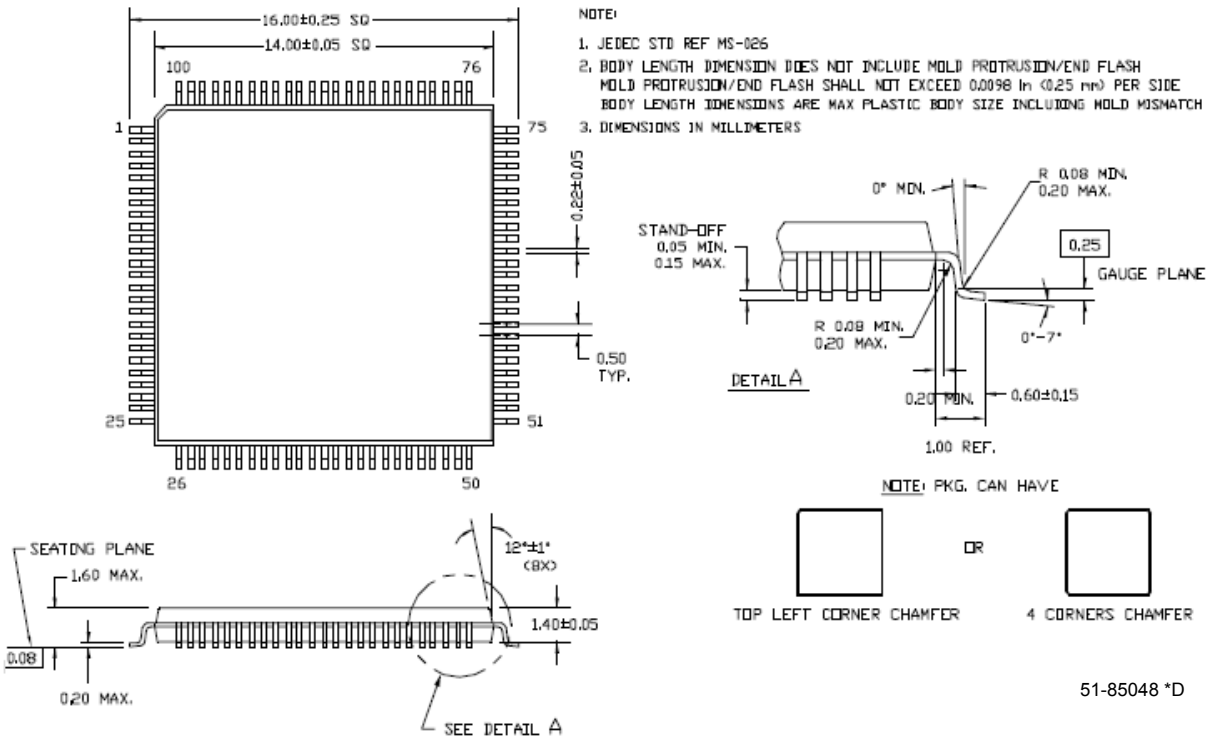
Figure 11-6. 100-Ball (6x6 mm) VFBGA



REFERENCE JEDEC MO-195C
PKG. WEIGHT: TBD (NEW PKG.)

51-85209 *C

Figure 11-7. 100-Pin (14x14 x 1.4 mm) TQFP



11.1 Thermal Impedance

Package	Typical θ_{JA} [26]
56-pin QFN[27]	12.93 °C/W
68-pin QFN[27]	13.05 °C/W
100-ball VFBGA	65 °C/W
100-pin TQFP	51 °C/W

11.2 Solder Reflow Peak Temperature

Following is the minimum solder reflow peak temperature to achieve good solderability.

Package	Minimum Peak Temperature[28]	Maximum Peak Temperature
56-pin QFN	240 °C	260 °C
68-pin QFN	240 °C	260 °C
100-ball VFBGA	240 °C	260 °C
100-pin TQFP	240 °C	260 °C

Notes
26. $T_J = T_A + POWER \times \theta_{JA}$
27. To achieve the thermal impedance specified for the QFN package,refer to "Application Notes for Surface Mount Assembly of Amkor's MicroLeadFrame (MLF) Packages" available at http://www.amkor.com.
28. 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

12. Development Tool Selection

12.1 Software

12.1.1 PSoC Designer

At the core of the PSoC development software suite is PSoC Designer, used to generate PSoC firmware applications. PSoC Designer is available free of charge at http://www.cypress.com and includes a free C compiler.

12.1.2 PSoC Programmer

Flexible enough to be used on the bench in development, yet suitable for factory programming, PSoC Programmer works either as a standalone programming application or it can operate directly from PSoC Designer. PSoC Programmer software is compatible with both PSoC ICE-Cube in-circuit emulator and PSoC MiniProg. PSoC programmer is available free of charge at http://www.cypress.com.

12.2 Development Kits

All development kits can be purchased from the Cypress Online Store.

12.2.1 CY3215-DK Basic Development Kit

The CY3215-DK is for prototyping and development with PSoC Designer. This kit supports in-circuit emulation, and the software interface enables you to run, halt, and single step the processor, and view the content of specific memory locations. Advance emulation features also supported through PSoC Designer. The kit includes:

- PSoC Designer software CD
- ICE-Cube in-circuit Emulator
- ICE Flex-Pod for CY8C29x66 family
- Cat-5 adapter
- Mini-Eval programming board
- 110 ~ 240 V power supply, Euro-Plug adapter
- iMAGEcraft C compiler (registration required)
- ISSP cable
- USB 2.0 cable and Blue Cat-5 cable
- Two CY8C29466-24PXI 28-PDIP chip samples

12.3 Evaluation Tools

All evaluation tools can be purchased from the Cypress Online Store.

12.3.1 CY3210-MiniProg1

The CY3210-MiniProg1 kit enables you to program PSoC devices via the MiniProg1 programming unit. The MiniProg is a small, compact prototyping programmer that connects to the PC via a provided USB 2.0 cable. The kit includes:

- MiniProg programming unit
- MiniEval socket programming and evaluation board
- 28-Pin CY8C29466-24PXI PDIP PSoC device sample
- 28-Pin CY8C27443-24PXI PDIP PSoC device sample
- PSoC Designer software CD
- Getting Started guide
- USB 2.0 cable

12.3.2 CY3210-PSoCEval1

The CY3210-PSoCEval1 kit features an evaluation board and the MiniProg1 programming unit. The evaluation board includes an LCD module, potentiometer, LEDs, and plenty of bread-boarding space to meet all of your evaluation needs. The kit includes:

- Evaluation board with LCD module
- MiniProg programming unit
- 28-Pin CY8C29466-24PXI PDIP PSoC device sample (2)
- PSoC Designer software CD
- Getting Started guide
- USB 2.0 cable

12.3.3 CY3214-PSoCEvalUSB

The CY3214-PSoCEvalUSB evaluation kit features a development board for the CY8C24794-24LFXI PSoC device. The board supports both USB and capacitive sensing development and debugging support. This evaluation board also includes an LCD module, potentiometer, LEDs, an enunciator and plenty of breadboarding space to meet all of your evaluation needs. The kit includes:

- PSoCEvalUSB board
- LCD module
- MIniProg programming unit
- Mini USB cable
- PSoC Designer and Example Projects CD
- Getting Started guide
- Wire pack

12.4 Device Programmers

All device programmers can be purchased from the Cypress Online Store.

12.4.1 CY3216 Modular Programmer

The CY3216 Modular Programmer kit features a modular programmer and the MiniProg1 programming unit. The modular programmer includes three programming module cards and supports multiple Cypress products. The kit includes:

- Modular programmer base
- Three programming module cards
- MiniProg programming unit
- PSoC Designer software CD
- Getting Started guide
- USB 2.0 cable

12.4.2 CY3207ISSP In-System Serial Programmer (ISSP)

The CY3207ISSP is a production programmer. It includes protection circuitry and an industrial case that is more robust than the MiniProg in a production-programming environment.

Note: CY3207ISSP needs special software and is not compatible with PSoC Programmer. The kit includes:

- CY3207 programmer unit
- PSoC ISSP software CD
- 110 ~ 240 V power supply, Euro-Plug adapter
- USB 2.0 cable

12.5 Accessories (Emulation and Programming)

Table 12-1. Emulation and Programming Accessories

Part #	Pin Package	Flex-Pod Kit[29]	Foot Kit[30]	Adapter[31]
CY8C24794-24LFXI	56-pin QFN	CY3250-24X94QFN	CY3250-56QFN-FK	Adapters can be found at http://www.emulation.com.
CY8C24894-24LFXI	56-pin QFN	CY3250-24X94QFN	CY3250-56QFN-FK	
CY8C24794-24LQXI	56-pin QFN	CY3250-24X94QFN	None	

Notes
29. Flex-Pod kit includes a practice flex-pod and a practice PCB, in addition to two flex-pods.
30. Foot kit includes surface mount feet that are soldered to the target PCB.
31. Programming adapter converts non-DIP package to DIP footprint. Specific details and ordering information for each of the adapters are found at http://www.emulation.com.

13. Ordering Information

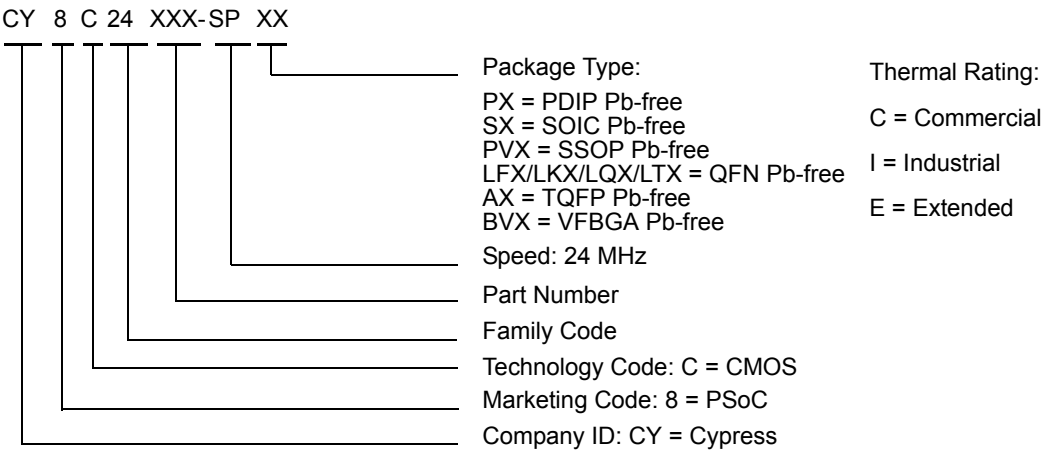
Table 13-1. CY8C24x94 PSoC Device's Key Features and Ordering Information

Package	Ordering Code	Flash (Bytes)	SRAM (Bytes)	Temperature Range	Digital Blocks	Analog Blocks	Digital I/O Pins	Analog Inputs	Analog Outputs	XRES Pin
100-pin OCD TQFP[32]	CY8C24094-24AXI	16K	1K	–40°C to +85°C	4	6	56	48	2	Yes
100-ball OCD (6x6 mm) VFBGA[32]	CY8C24094-24BVXI	16K	1K	–40°C to +85°C	4	6	56	48	2	Yes
68-pin QFN (Sawn)	CY8C24094-24LTXI	16K	1K	–40°C to +85°C	4	6	56	48	2	Yes
68-pin QFN (Sawn) (Tape and Reel)	CY8C24094-24LTXIT	16K	1K	–40°C to +85°C	4	6	56	48	2	Yes
56-pin (8x8 mm) QFN	CY8C24794-24LFXI	16K	1K	–40°C to +85°C	4	6	50	48	2	No
56-pin (8x8 mm) QFN (Tape and Reel)	CY8C24794-24LFXIT	16K	1K	–40°C to +85°C	4	6	50	48	2	No
56-pin (8x8 mm) QFN (Sawn)	CY8C24794-24LTXI	16K	1K	–40°C to +85°C	4	6	50	48	2	No
56-pin (8x8 mm) QFN (Sawn) (Tape and Reel)	CY8C24794-24LTXIT	16K	1K	–40°C to +85°C	4	6	50	48	2	No
56-pin (8x8 mm) QFN	CY8C24894-24LFXI	16K	1K	–40°C to +85°C	4	6	49	47	2	Yes
56-pin (8x8 mm) QFN (Tape and Reel)	CY8C24894-24LFXIT	16K	1K	–40°C to +85°C	4	6	49	47	2	Yes
56-pin (8x8 mm) QFN (Sawn)	CY8C24894-24LTXI	16K	1K	–40°C to +85°C	4	6	49	47	2	Yes
56-pin (8x8 mm) QFN (Sawn) (Tape and Reel)	CY8C24894-24LTXIT	16K	1K	–40°C to +85°C	4	6	49	47	2	Yes
100-ball (6x6 mm) VFBGA	CY8C24994-24BVXI	16K	1K	–40°C to +85°C	4	6	56	48	2	Yes
68-pin QFN (Sawn)	CY8C24994-24LTXI	16K	1K	–40°C to +85°C	4	6	56	48	2	Yes
68-pin QFN (Sawn) (Tape and Reel)	CY8C24994-24LTXIT	16K	1K	–40°C to +85°C	4	6	56	48	2	Yes

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

Notes
32. This part may be used for in-circuit debugging. It is NOT available for production

13.1 Ordering Code Definitions



14. Document Conventions

14.1 Acronyms Used

The following table lists the acronyms that are used in this document.

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
ECO	external crystal oscillator
EEPROM	electrically erasable programmable read-only memory
FSR	full scale range
GPIO	general purpose I/O
GUI	graphical user interface
HBM	human body model
ICE	in-circuit emulator
ILO	internal low speed oscillator
IMO	internal main oscillator
I/O	input/output
IPOR	imprecise power on reset
LSb	least-significant bit
LVD	low voltage detect
MSb	most-significant bit
PC	program counter
PLL	phase-locked loop
POR	power on reset
PPOR	precision power on reset
PSoC®	Programmable System-on-Chip™
PWM	pulse width modulator
SC	switched capacitor
SRAM	static random access memory

14.2 Units of Measure

Table 14-1. Units of Measure

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

14.3 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’ or ‘b’ are decimal.

15. Document History Page

Document Title: CY8C24094, CY8C24794, CY8C24894, CY8C24994 PSoC® Programmable System-on-Chip Document Number: 38-12018				
Rev.	**ECN No.**	**Submission Date**	**Orig. of Change**	**Description of Change**
**	133189	01.27.2004	NWJ	New silicon and new document – Advance Data Sheet.
*A	251672	See ECN	SFV	First Preliminary Data Sheet. Changed title to encompass only the CY8C24794 because the CY8C24494 and CY8C24694 are not being offered by Cypress.
*B	289742	See ECN	HMT	Add standard DS items from SFV memo. Add Analog Input Mux on pinouts. 2 MACs. Change 512 bytes of SRAM to 1K. Add dimension key to package. Remove HAPI. Update diagrams, registers and specs.
*C	335236	See ECN	HMT	Add CY logo. Update CY copyright. Update new CY.com URLs. Re-add ISSP programming pinout notation. Add Reflow Temp. table. Update features (MAC, Oscillator, and voltage range), registers (INT_CLR2/MSK2, second MAC), and specs. (Rext, IMO, analog output buffer...).
*D	344318	See ECN	HMT	Add new color and logo. Expand analog arch. diagram. Fix I/O #. Update Electrical Specifications.
*E	346774	See ECN	HMT	Add USB temperature specifications. Make data sheet Final.
*F	349566	See ECN	HMT	Remove USB logo. Add URL to preferred dimensions for mounting MLF packages.
*G	393164	See ECN	HMT	Add new device, CY8C24894 56-pin MLF with XRES pin. Add Fimousb3v char. to specs. Upgrade to CY Perform logo and update corporate address and copyright.
*H	469243	See ECN	HMT	Add ISSP note to pinout tables. Update typical and recommended Storage Temperature per industrial specs. Update Low Output Level maximum I/OL budget. Add FLS_PR1 to Register Map Bank 1 for users to specify which Flash bank should be used for SROM operations. Add two new devices for a 68-pin QFN and 100-ball VFBGA under RPNs: CY8C24094 and CY8C24994. Add two packages for 68-pin QFN. Add OCD non-production pinouts and package diagrams. Update CY branding and QFN convention. Add new Dev. Tool section. Update copyright and trademarks.
*I	561158	See ECN	HMT	Add Low Power Comparator (LPC) AC/DC electrical spec. tables. Add CY8C20x34 to PSoC Device Characteristics table. Add detailed dimensions to 56-pin QFN package diagram and update revision. Secure one package diagram/manufacturing per QFN. Update emulation pod/feet kit part numbers. Fix pinout type-o per TestTrack.
*J	728238	See ECN	HMT	Add CapSense SNR requirement reference. Update figure standards. Update Technical Training paragraphs. Add QFN package clarifications and dimensions. Update ECN-ed Amkor dimensioned QFN package diagram revisions. Reword SNR reference. Add new 56-pin QFN spec.
*K	2552459	08/14/08	AZIE/PYRS	Add footnote on AGND descriptions to avoid using P2[4] for digital signaling as it may add noise to AGND. Remove reference to CMP_GO_EN1 in Map Bank 1 Table on Address 65; this register has no functionality on 24xxx. Add footnote on die sales. Add description 'Optional External Clock Input' on P1[4] to match description of P1[4].
*L	2616550	12/05/08	OGNE/PYRS	Updated Programmable Pin Configuration detail. Changed title from PSoC® Mixed-Signal Array to PSoC® Programmable System-on-Chip™
*M	2657956	02/11/09	DPT/PYRS	Added package diagram 001-09618 and updated Ordering Information table

Document Title: CY8C24094, CY8C24794, CY8C24894, CY8C24994 PSoC® Programmable System-on-Chip Document Number: 38-12018				
*N	2708135	05/18/2009	BRW	Added Note in the Pin Information section on page 8. Removed reference to Hi-Tech Lite Compiler in the section Development Tools Selection on page 42.
*O	2718162	06/11/2009	DPT	Added 56-Pin QFN (Sawn) package diagram and updated ordering information
*P	2762161	09/10/2009	RLRM	Updated the following parameters: DC_{ILO}, F32K_U, F_{IMO6}, $T_{POWERUP}$, T_{ERASE_ALL}, $T_{PROGRAM\_HOT}$, and $T_{PROGRAM\_COLD}$. Added SR_{POWER_UP} parameter in AC specs table.
*Q	2768530	09/24/09	RLRM	Ordering Information table: Changed XRES Pin value for CY8C24894-24LTXI and CY8C24894-24LTXIT to 'Yes'.
*R	2817938	11/30/09	KRIS	Ordering Information: Updated CY8C24894-24LTXI and CY8C24894-24LTXIT parts as Sawn and updated the Digital I/O and Analog Pin values Added Contents page. Updated 68 QFN package diagram (51-85124)
*S	2846641	1/12/10	RLRM	Added package diagram 001-58740 and updated Development Tools section.
*T	2867363	01/27/10	ANUP	Modified Note 9 to remove voltage range 2.4 V to 3.0 V
*U	2901653	03/30/2010	NJF	Updated Cypress website links Added T_{XRST}, DC24M, $T_{BAKETEMP}$ and $T_{BAKETIME}$ parameters Removed reference to 2.4 V Removed sections 'Third Party Tools' 'Build a PSoC Emulator into your Board' Updated package diagrams Removed inactive parts from ordering information table.
*V	2938528	05/28/2010	VMAD	Updated content to match current style guide and datasheet template. No technical updates

16. Sales, Solutions, and Legal Information

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PSoC 1 | PSoC 3 | PSoC 5