

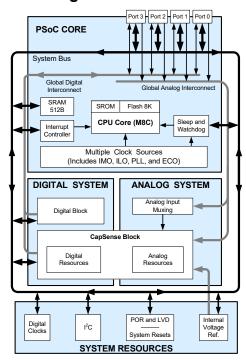
Automotive PSoC[®] Programmable System-on-Chip™

Features

- Automotive Electronics Council (AEC) Q100 qualified
- Powerful Harvard-architecture processor
 - M8C processor speeds up to 24 MHz
 - □ Low power at high speed
 - □ Operating voltage: 3.0 V to 5.25 V
 - ☐ Automotive temperature range: -40 °C to +85 °C
- Advanced peripherals
 - □ One CapSense[®] block:
 - · Provides configurable capacitive sensing elements
 - Supports combination of CapSense buttons, sliders, touchpads, and proximity sensors
 - □ One limited digital PSoC[®] block provides:
 - 8-bit timer, counter, or pulse-width modulator (PWM)
 - Half-duplex UART
 - SPI slave
 - · Connectable to all general purpose I/O (GPIO) pins
- Flexible on-chip memory
 - 8 KB flash program storage
 - □ 512 bytes SRAM data storage
 - □ In-system serial programming (ISSP)
 - □ Partial flash updates
 - □ Flexible protection modes
 - □ EEPROM emulation in flash
- Complete development tools
 - □ Free development software (PSoC Designer™)
 - □ Full-featured in-circuit emulator (ICE) and programmer
 - □ Full-speed emulation
 - $\ensuremath{\square}$ Complex breakpoint structure
 - □ 128 KB trace memory
- Precision, programmable clocking
 - □ Internal ±5% 24 MHz oscillator
 - □ Internal low-speed, low-power oscillator for Watchdog and Sleep functionality
 - □ Optional external oscillator, up to 24 MHz
- Programmable pin configurations
 - □ 25 mA sink, 10 mA drive on all GPIOs

- □ Pull-up, pull-down, high Z, strong, or open drain drive modes on all GPIOs
- ☐ Analog input on all GPIOs
- □ Configurable interrupt on all GPIOs
- Versatile analog mux
 - □ Common internal analog bus
 - □ Simultaneous connection of I/O combinations
- Additional system resources
 - □ Inter-Integrated Circuit (I²C™) master, slave, or multi-master operation up to 400 kHz
 - □ Watchdog and sleep timers
 - □ User-configurable low-voltage detection (LVD)
 - □ Integrated supervisory circuit
 - □ On-chip precision voltage reference

Logic Block Diagram





Contents

PSoC Functional Overview	3
The PSoC Core	3
The Digital System	
The Analog System	
Additional System Resources	4
PSoC Device Characteristics	5
Getting Started	5
Application Notes	5
Development Kits	5
Training	
CYPros Consultants	
Solutions Library	5
Technical Support	5
Development Tools	
PSoC Designer Software Subsystems	
Designing with PSoC Designer	
Select Components	
Configure Components	
Organize and Connect	
Generate, Verify, and Debug	
Pinouts	
20-Pin Part Pinout	
28-Pin Part Pinout	
Registers	
Register Conventions	
Register Mapping Tables	
Electrical Specifications	
Absolute Maximum Ratings	
Operating Temperature	14

DC Electrical Characteristics	15
AC Electrical Characteristics	18
Packaging Information	
Packaging Diagram	23
Thermal Impedances	
Solder Reflow Specifications	
Tape and Reel Information	
Development Tool Selection	
Software	
Development Kits	
Evaluation Tools	
Device Programmers	
Accessories (Emulation and Programming)	
Ordering Information	
Ordering Code Definitions	
Acronyms	
Reference Documents	
Document Conventions	31
Units of Measure	31
Numeric Conventions	
Glossary	
Document History Page	36
Sales, Solutions, and Legal Information	
Worldwide Sales and Design Support	
Products	
PSoC® Solutions	38
Cypress Developer Community	38
Technical Support	



PSoC Functional Overview

The PSoC family consists of many devices with on-chip controllers. These devices are designed to replace multiple traditional microcontroller unit (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 CPU, flash program memory, SRAM data memory, and configurable I/O are included in a range of convenient pinouts.

The PSoC architecture, as illustrated in the Logic Block Diagram on page 1, comprises of four main areas: the core, the system resources, the digital system, and the analog system. Configurable global bus resources allow all the device resources to be combined into a complete custom system. Each CY8C21x12 device includes one limited digital block and one CapSense block. Depending on the PSoC package, up to 24 GPIOs are also included. The GPIOs provide access to the global digital and analog interconnects.

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 an 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 additional capability, such as digital clocks for increased flexibility, 12 C functionality for implementing an 12 C master, slave, or multi-master, an internal voltage reference that provides an absolute value of 1.3 V to a number of PSoC subsystems, and various system resets supported by the M8C.

The Digital System is composed of a programmable limited digital block and fixed-function digital resources inside the CapSense block. The limited digital block can be configured into a number of digital peripherals. The fixed-function digital resources in the CapSense block provide external modulation signals, measurement timing, and measurement conversion. The digital resources can be connected to the GPIO through a series of global buses that provide very flexible routing options.

The Analog System is composed of a comparator and a filter that are used in the CapSense block to implement capacitive sensing measurement.

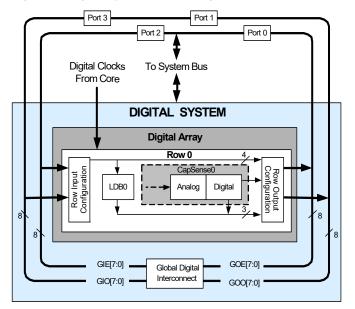
The Digital System

The Digital System is composed of one digital block. This block is an 8-bit resource that can implement various 8-bit digital peripherals. Digital peripheral configurations include those listed.

- PWM (8-bit)
- Counter (8-bit)
- Timer (8-bit)
- Half-duplex 8-bit UART with selectable parity
- SPI slave
- I²C master, slave, or multi-master (implemented in a dedicated I²C block)

The digital block can be 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.

Figure 1. Digital System Block Diagram



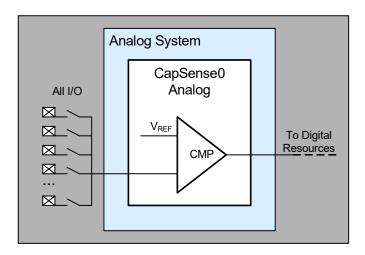


The Analog System

The Analog System is composed of analog resources inside of the CapSense block. These resources are used to implement a flexible capacitive sensing and measurement module. The analog resources in the CapSense block are listed.

- Comparator used in capacitance-to-digital conversion
- Fixed, absolute reference or adjustable, ratiometric reference can be used with the comparator
- Low-pass filter converts a digital bit stream into the adjustable, ratiometric analog reference

Figure 2. Analog System Block Diagram



The Analog Multiplexer System

The Analog Mux Bus can connect to every GPIO pin. Pins can be connected to the bus individually or in any combination. The bus also connects to the analog system. 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 allows analog input from any I/O pin.
- Crosspoint connection between any I/O pin combination.

Additional System Resources

System resources, some of which have been previously listed, provide additional capability useful for complete systems. Brief statements describing the merits of each system resource are presented.

- Digital clock dividers provide three customizable clock frequencies for use in applications. The clocks can be routed to both the digital and analog systems.
- The I²C module provides communication up to 400 kHz over two wires. Slave, master, and multi-master modes are all supported.
- LVD interrupts can 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 voltage reference provides an absolute reference for the analog system.
- Versatile analog multiplexer system.



PSoC Device Characteristics

Depending on your PSoC device characteristics, the digital and analog systems can have a varying number of digital and analog blocks. Table 1 lists the resources available for specific PSoC device groups. The PSoC device covered by this datasheet is highlighted in Table 1

Table 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 ^[1]	up to 64	4	16	up to 12	4	4	12	2K	32K
CY8C28xxx	up to 44	up to 3	up to 12	up to 44	up to 4	up to 6	up to 12 + 4 ^[2]	1K	16K
CY8C27x43	up to 44	2	8	up to 12	4	4	12	256	16K
CY8C24x94 ^[1]	up to 56	1	4	up to 48	2	2	6	1K	16K
CY8C24x23A ^[1]	up to 24	1	4	up to 12	2	2	6	256	4K
CY8C23x33	up to 26	1	4	up to 12	2	2	4	256	8K
CY8C22x45 ^[1]	up to 38	2	8	up to 38	0	4	6 ^[2]	1K	16K
CY8C21x45 ^[1]	up to 24	1	4	up to 24	0	4	6 ^[2]	512	8K
CY8C21x34 ^[1]	up to 28	1	4	28	0	2	4 ^[2]	512	8K
CY8C21x23	up to 16	1	4	up to 8	0	2	4 ^[2]	256	4K
CY8C21x12 ^[1]	up to 24	1	1 ^[2]	24	0	0	1 ^[2]	512	8K
CY8C20x34 ^[1]	up to 28	0	0	up to 28	0	0	3 ^[2,3]	512	8K
CY8C20xx6	up to 36	0	0	up to 36	0	0	3 ^[2,3]	up to 2K	up to 32K

Getting Started

For in-depth information, along with detailed programming details, see the $PSoC^{\otimes}$ Technical Reference Manual.

For up-to-date ordering, packaging, and electrical specification information, see the latest PSoC device datasheets on the web.

Application Notes

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

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.

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.

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.

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.

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.

Notes

- 1. Automotive qualified devices available in this group.
- 2. Limited analog functionality.
- 3. Two analog blocks and one CapSense® block.



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 I²C 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.

PSoC Designer Software Subsystems

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 ADCs, DACs, amplifiers, and filters. Configure the user modules for your chosen application and connect them to each other and to the proper pins. Then generate your project. This prepopulates your project with APIs and libraries that you can use to program your application.

The 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 an application.

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 are 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.

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.

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.

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.



Designing with PSoC Designer

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

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

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

Select Components

PSoC Designer provides a library of pre-built, pre-tested hardware peripheral components called "user modules." User modules make selecting and implementing peripheral devices, both analog and digital, simple.

Configure Components

Each of the User Modules 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 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.

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.

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 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.



Pinouts

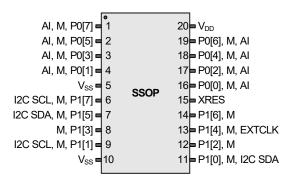
TheCY8C21x12 PSoC device is available in a variety of packages which are listed and illustrated in the following tables. Every port pin (labeled with a "P") is capable of digital I/O and connection to the common analog bus. However, V_{SS} , V_{DD} , and XRES are not capable of digital I/O.

20-Pin Part Pinout

Table 2. 20-Pin Part Pinout (shrink small-outline package (SSOP))

Pin	Ту	pe	Name	Description					
No.	Digital	Analog	Ivaille	Description					
1	I/O	I, M	P0[7]	Analog column mux input					
2	I/O	I, M	P0[5]	Analog column mux input					
3	I/O	I, M	P0[3]	Analog column mux input, C _{MOD} capacitor pin					
4	I/O	I, M	P0[1]	Analog column mux input, C _{MOD} capacitor pin					
5	Po	wer	V_{SS}	Ground connection					
6	I/O	М	P1[7]	I ² C serial clock (SCL)					
7	I/O	М	P1[5]	I ² C serial data (SDA)					
8	I/O	М	P1[3]						
9	I/O	М	P1[1]	I ² C SCL, ISSP-SCLK ^[4]					
10	Power		V_{SS}	Ground connection					
11	I/O	М	P1[0]	I ² C SDA, ISSP-SDATA ^[4]					
12	I/O	М	P1[2]						
13	I/O	М	P1[4]	Optional external clock input (EXTCLK)					
14	I/O	М	P1[6]						
15	In	put	XRES	Active high external reset with internal pull-down					
16	I/O	I, M	P0[0]	Analog column mux input					
17	I/O	I, M	P0[2]	Analog column mux input					
18	I/O	I, M	P0[4]	Analog column mux input					
19	I/O I, M P0[6]		P0[6]	Analog column mux input					
20	Power		V_{DD}	Supply voltage					

Figure 3. CY8C21312 20-Pin PSoC Device



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

Note

^{4.} These are the ISSP pins, which are not high Z when coming out of POR. See the PSoC Technical Reference Manual for details.

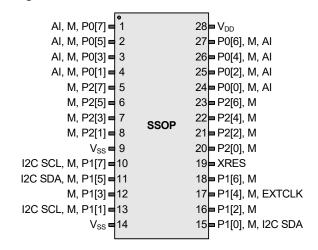


28-Pin Part Pinout

Table 3. 28-Pin Part Pinout (SSOP)

Pin	Ту	pe					
No.	Digital	Analog	Name	Description			
1	I/O	I, M	P0[7]	Analog column mux input			
2	I/O	I, M	P0[5]	Analog column mux input			
3	I/O	I, M	P0[3]	Analog column mux input, C _{MOD} capacitor pin			
4	I/O	I, M	P0[1]	Analog column mux input, C _{MOD} capacitor pin			
5	I/O	М	P2[7]				
6	I/O	М	P2[5]				
7	I/O	М	P2[3]				
8	I/O	М	P2[1]				
9	Pov	wer	V_{SS}	Ground connection			
10	I/O	М	P1[7]	I ² C SCL			
11	I/O	М	P1[5]	I ² C SDA			
12	I/O	М	P1[3]				
13	I/O	М	P1[1]	I ² C SCL, ISSP-SCLK ^[5]			
14	Power		V _{SS}	Ground connection			
15	I/O	М	P1[0]	I ² C SDA, ISSP-SDATA ^[5]			
16	I/O	М	P1[2]				
17	I/O	М	P1[4]	Optional EXTCLK			
18	I/O	М	P1[6]				
19	Inp	out	XRES	Active high external reset with internal pull-down			
20	I/O	М	P2[0]				
21	I/O	М	P2[2]				
22	I/O	М	P2[4]				
23	I/O	М	P2[6]				
24	I/O	I, M	P0[0]	Analog column mux input			
25	I/O	I, M	P0[2]	Analog column mux input			
26	I/O	I, M	P0[4]	Analog column mux input			
27	I/O I, M P0[P0[6]	Analog column mux input			
28	Pov	wer	V_{DD}	Supply voltage			

Figure 4. CY8C21512 28-Pin PSoC Device



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

Note

^{5.} These are the ISSP pins, which are not high Z when coming out of POR. See the PSoC Technical Reference Manual for details.



Registers

Register Conventions

This section lists the registers of the CY8C21x12 PSoC device. For detailed register information, refer to the *PSoC Technical Reference Manual*.

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

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

Register Mapping Tables

The PSoC device has a total register address space of 512 bytes. The register space is referred to as I/O space and is divided into two banks, bank 0 and bank 1. The XIO bit in the Flag register (CPU_F) determines which bank the user is currently in. When the XIO bit is set to '1', the user is in bank 1.

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



Table 4. Register Map 0 Table: User Space

Table 4. Regist		labie: Us	er Space	1 4 4 4 4			1 A al al			1 A al al a	
Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access	Name	Addr (0,Hex)	Access
PRT0DR	00	RW		40			80			C0	
PRT0IE	01	RW		41			81			C1	
PRT0GS	02	RW		42			82			C2	
PRT0DM2	03	RW		43			83			C3	
PRT1DR	04	RW		44		CSREF_CR1	84	RW		C4	
PRT1IE	05	RW		45		_	85			C5	
PRT1GS	06	RW		46			86			C6	
PRT1DM2	07	RW		47			87			C7	
PRT2DR	08	RW		48			88			C8	
PRT2IE	09	RW		49			89			C9	
PRT2GS	0A	RW		4A			8A			CA	
PRT2DM2	0B	RW		4B			8B	<u> </u>		CB	
FIXIZDIVIZ	OC OB	IXVV		4C			8C			CC	
	0D			_			8D				
				4D						CD	
	0E			4E			8E			CE	
	0F			4F			8F			CF	
	10			50			90		CUR_PP	D0	RW
	11			51			91		STK_PP	D1	RW
	12			52			92			D2	
	13			53			93		IDX_PP	D3	RW
	14			54			94		MVR_PP	D4	RW
	15		1	55			95		MVW_PP	D5	RW
	16	<u> </u>	1	56			96	<u> </u>	I2C CFG	D6	RW
	17			57			97		I2C_SCR	D7	#
	18			58			98		I2C DR	D8	RW
	19			59			99		I2C_MSCR	D9	#
	1A			5A			9A		INT CLR0	DA	RW
	1B	<u> </u>		5B			9B	<u> </u>	INT_CLR1	DB	RW
	1C			5C			9C		IIVI_CLIVI	DC	1700
	1D								INIT OLDO		DW
				5D			9D		INT_CLR3	DD	RW
	1E			5E			9E		INT_MSK3	DE	RW
	1F			5F			9F			DF	
CSCNT_DR0	20	#		60			A0		INT_MSK0	E0	RW
CSCNT_DR1	21	W	AMUX_CFG	61	RW		A1		INT_MSK1	E1	RW
CSCNT_DR2	22	RW	CSCMP_CR0	62	RW		A2		INT_VC	E2	RC
CSCNT_CR0	23	#		63			A3		RES_WDT	E3	W
CSMOD0_DR0	24	#	CSCMP_CR1	64	#		A4			E4	
CSMOD0_DR1	25	W		65			A5			E5	
CSMOD0_DR2	26	RW	CSCMP_CR2	66	RW		A6		CSCMP_CR5	E6	RW
CSMOD0 CR0	27	#	_	67			A7		CSCMP_CR6	E7	RW
CSMOD1_DR0	28	#		68			A8			E8	
CSMOD1 DR1	29	W	CSREF_CR0	69	#		A9			E9	
CSMOD1_DR2	2A	RW	CONET_CINO	6A	"		AA			EA	
CSMOD1_CR0	2B	#		6B			AB			EB	
LDB0_DR0	2C	#	TMP_DR0	6C	RW		AC	1		EC	
								ļ			
LDB0_DR1	2D	W	TMP_DR1	6D	RW		AD			ED	
LDB0_DR2	2E	RW	TMP_DR2	6E	RW		AE	ļ		EE	
LDB0_CR0	2F	#	TMP_DR3	6F	RW	DDIOE:	AF	5		EF	
	30			70		RDI0RI	В0	RW		F0	
	31			71		RDI0SYN	B1	RW		F1	
	32			72		RDI0IS	B2	RW		F2	
<u> </u>	33			73		RDI0LT0	В3	RW		F3	
	34			74		RDI0LT1	B4	RW		F4	
	35			75		RDI0RO0	B5	RW		F5	
	36	1	CSCMP_CR3	76	RW	RDI0RO1	В6	RW		F6	
	37		CSCMP_CR4	77	RW		B7		CPU_F	F7	RL
	38	<u> </u>	t -	78			B8	<u> </u>		F8	
	39	1	1	79	1		B9	1		F9	
	3A	 	1	7A		1	BA	 	1	FA	
	3B	-	1	7B			BB	-		FB	
	3C	 	 	7C			BC	 		FC	
	3D	 	 	7D			BD	 		FD	
	3D 3E	<u> </u>	!	7D 7E			BE	<u> </u>	CPU_SCR1	FE	
		ļ			1			ļ			#
	3F	<u> </u>		7F			BF		CPU_SCR0	FF	#

Blank fields are Reserved and must not be accessed.

Access is bit specific.



Table 5. Register Map 1 Table: Configuration Space

PRTODION	Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access	Name	Addr (1,Hex)	Access
PRTOIDNÍ	PRTODMO		RW									
PRIORICO 02 RW 42 42 82 82 CC CR PRIORICO 03 RW 44 8 84 CC CR PRIORICO 04 RW 44 8 84 CC CR PRIORICO 06 RW 44 8 88 CC CR PRIORICO 06 RW 45 88 CC CR PRIORICO 06 RW 46 88 CC CR PRIORICO 07 RW 47 87 CC CR PRIORICO 07 RW 48 88 CC CR PRIORICO 08 RW 48 88 CC CR PRIORICO 09 RW 48 88 CC CR PRIORICO 09 RW 49 89 CC CR PRIORICO 0A RW 4A 88 88 CC CR PRIORICO 0A RW 4B 88 CR PRI					_							
PRYFOLICIT 03 RW 43 83 83 C.C. PRYFOLIDM 04 RW 44 84 84 C.C. PRYFOLIDM 05 RW 45 85 C.C. PRYFOLIDM 05 RW 45 85 C.C. PRYFOLICIT 07 RW 47 87 C.C. PRYFOLICIT 07 RW 47 87 C.C. PRYFOLICIT 07 RW 47 87 C.C. PRYFOLICIT 07 RW 47 88 88 C.C. PRYFOLICIT 09 RW 49 88 C.C. PRYFOLIDM 09 RW 49 88 C.C. PRYFOLIDM 09 RW 44 88 88 C.C. PRYFOLIDM 09 RW 44 88 88 C.C. PRYFOLICIT 08 RW 48 C.C. PRYFOLICIT 08 C.C. PRYFOLICIT 08 RW 48 C.C. PRYFOLICIT 08 C.C. PRYFOLICI			1	.								
PRETIDINO 04 RW 44 84 84 CC PRETICO 08 RW 46 86 CC PRETICO 07 RW 47 87 CC PRETICO 08 RW 46 86 CC PRETICO 07 RW 47 87 CC PRETICO 08 RW 48 88 CC PRETICO 08 RW 48 88 CC PRETICO 08 RW 48 88 CC PRETICO 09 RW 49 89 CC PRETICO 09 RW 49 89 CC PRETICO 00 RW 44 88 88 CC PRETICO 09 RW 44 88 88 CC PRETICO 09 RW 44 88 88 CC PRETICO 09 RW 44 88 88 CC PRETICO 00 RW 44 88 88 CC OC 00 RW 44 88 CC OC 00 RW 44 88 88 88 CC OC 0			1									
PRETIDIM												
PRETICO 06 RW 46 86 CC PRETZIMO 7 RW 47 87 CC PRETZIMO 08 RW 44 88 88 CC PRETZIMO 09 RW 48 88 CC PRETZIMO 09 RW 48 88 CC PRETZIMO 09 RW 48 88 CC PRETZIMO 09 RW 44 88 88												
PRETICIO 97 RW 47 87 87 C. PRIZDMI 09 RW 49 89 89												
PRIZIDMO												
PRT2IDN1			1								C7	
PRT2ICO 0A RW 4A 4A 8B 8B 6C CC 9 CC 0C CC 0C CC 0C CC CC 0C CC CC CC CC											C8	
PRT2IC1		09			49						C9	
OC	PRT2IC0	0A			4A			8A			CA	
OD	PRT2IC1	0B	RW		4B			8B			СВ	
OE		0C			4C			8C			CC	
OF		0D			4D			8D			CD	
OF		0E			4E			8E			CE	
10											CF	
11		-		1						GDL O IN	D0	RW
12												RW
13												RW
14			-	1								RW
15										GDI_E_UU		KVV
16												ļ
17												
18												
19											D7	
1A											D8	RW
18					59						D9	RW
1C		1A			5A			9A			DA	RW
1D		1B			5B			9B		MUX_CR3	DB	RW
1E		1C			5C			9C			DC	
1E		1D		1	5D			9D			DD	
1F					5E			9E		OSC CR4	DE	RW
CSCNT_CR1 20 RW CSCLK_CR0 60 RW A0 OSC_CR0 EE CSCNT_CR2 21 RW CSCLK_CR1 61 RW A1 OSC_CR2 EZ CSCNT_CR3 22 RW 62 A2 OSC_CR2 EZ CSMODD_CR1 24 RW CSCM_CR7 64 RW A4 VLT_CR ES CSMODD_CR2 25 RW 65 A5 A5 EC CSMODO_CR3 26 RW CSREF_CR3 66 RW A6 CSREF_CR4 ES CSMODD_CR3 26 RW CSREF_CR3 66 RW A6 CSREF_CR4 ES CSMODD_CR1 28 RW 68 A8 IMO_TR ES CSMODD_CR2 29 RW 68 AA AA IMO_TR ES CSMODD_CR3 2A RW 6A AA AA BDG_TR ES CSMODD_CR2 29 RW											DF	RW
CSCNT_CR2	SCNT CR1		RW	CSCLK CR0		RW						RW
CSCNT_CR3 22 RW 62 A2 OSC_CR2 E2 CSMODO_CR1 24 RW CSCMP_CR7 64 RW A4 VLT_CR E3 CSMODO_CR2 25 RW CSCMP_CR7 64 RW A4 VLT_CMP E4 CSMODO_CR3 26 RW CSCMP_CR8 67 RW A6 CSREF_CR4 E6 CSMODO_CR1 28 RW 68 A8 A8 IMO_TR E6 CSMODO_CR2 29 RW 69 A9 ILO_TR E6 CSMODO_CR3 2A RW 6A AA BIG_TR E6 CSMODO_CR2 29 RW 69 A9 ILO_TR E6 CSMODO_CR3 2A RW AA BIG_TR E6 CSMODO_CR3 2A RW AA AB ECO_TR E6 CSMODO_CR3 2A RW AB ECO_TR E6 CSMODO_CR3												RW
CSMODD_CR1			1	OOOLIT_OITI		1777						RW
CSMODO_CR1 24 RW CSCMP_CR7 64 RW A4 VLT_CMP E4 CSMODO_CR2 25 RW 65 A5 E5 A5 E5 CSMODO_CR3 26 RW CSREF_CR3 66 RW A6 CSREF_CR4 E6 27 CSCMP_CR8 67 RW A7 E7 E7 CSMOD1_CR1 28 RW 68 A8 IMO_TR E6 E7 CSMOD1_CR2 29 RW 69 A9 ILO_TR E6 E6 CSCMC_CR2 6B RW AA BDG_TR E7	000111_0110		1700	CODEE CD2		DW						RW
CSMODO_CR2 25 RW 65 A5 E5 CSMODO_CR3 26 RW CSREF_CR3 66 RW A6 CSREF_CR4 E6 27 C CSCMP_CR8 67 RW A7 E7 E7 CSMOD1_CR1 28 RW 68 A8 IMO_TR E5 CSMOD1_CR2 29 RW 69 A9 ILO_TR E5 CSMOD1_CR3 2A RW 6A AA AB EC_TR E5 CSMOD1_CR3 2A RW 6A AA AA BDG_TR E7 CSMOD1_CR3 2A RW 6A AA AA BDG_TR E7 CSMOD1_CR3 2A RW 6A AA AA BDG_TR E7 CSMOD1_CR3 2B CSCLK_CR2 6B RW AB EC_TR E7 LDB0_IN 2C RW TMP_DR1 6D RW AD E5	OCMODO ODA		DW	COREF_CRZ								
CSMODO_CR3 26 RW CSREF_CR3 66 RW A6 CSREF_CR4 E6 27 CSCMP_CR8 67 RW A7 E7 E7 CSMOD1_CR1 28 RW 69 A8 IMO_TR E8 CSMOD1_CR2 29 RW 69 A9 ILO_TR E9 CSMOD1_CR3 2A RW 6A AA BDG_TR E4 CSMOD1_CR3 2A RW 6A AA AB ECO_TR E9 CSMOD1_CR3 2A RW 6A AA AB ECO_TR E9 CSMOD1_CR3 2A RW AB ECO_TR E9 CSMOD1_CR3 2A RW AB ECO_TR E9 CSCLK_CR2 6B RW AC BD ECO_TR E9 LDB0_FN 2C RW TMP_DR1 6D RW AD E9 E9 LDB0_OU 2E RW				CSCMP_CR/		RW				VLI_CMP		R
CSMOD1_CR1 28												
CSMOD1_CR1 28 RW 68 A8 IMO_TR E8 CSMOD1_CR2 29 RW 69 A9 ILO_TR E9 CSMOD1_CR3 2A RW 6A AA BDG_TR EA CSMOD1_CR3 2A RW 6A AA AB ECO_TR E9 LDB0_CR3 2B CSCLK_CR2 6B RW AB ECO_TR E8 LDB0_FN 2C RW TMP_DR0 6C RW AC ECO_TR E8 LDB0_IN 2D RW TMP_DR1 6D RW AD EC ED LDB0_OU 2E RW TMP_DR3 6F RW AF EF	CSMOD0_CR3		RW							CSREF_CR4		RW
CSMOD1_CR2 29 RW 69 A9 ILO_TR ESC CSMOD1_CR3 2A RW 6A AA BDG_TR EA LDB0_FN 2C RW TMP_DR0 6C RW AC ECO_TR EE LDB0_IN 2D RW TMP_DR1 6D RW AD EC EC LDB0_OU 2E RW TMP_DR2 6E RW AF EE EC LDB0_OU 2E RW TMP_DR3 6F RW AF EF EE 30 70 RDIORI BO RW FC EF				CSCMP_CR8		RW					E7	
CSMOD1_CR3 2A RW 6A AA BDG_TR EA LDB0_FN 2C RW TMP_DR0 6C RW AC ECO_TR EE LDB0_IN 2D RW TMP_DR1 6D RW AD EC LDB0_OU 2E RW TMP_DR2 6E RW AE EE 2F TMP_DR3 6F RW AF EF 30 70 RDIORI BO RW FC 31 71 RDIOSYN B1 RW F2 33 73 RDIOLTO B3 RW F3 34 74 RDIOLTO B3 RW F4 35 75 RDIOROO B5 RW F6 36 76 RDIOROO B6 RW F6 37 77 B7 B7 CPU_F F7 38 78 B8 B8 F8			1								E8	W
DB0_FN										_	E9	W
LDB0_FN 2C	CSMOD1_CR3	2A	RW		6A			AA		BDG_TR	EA	RW
LDB0_IN 2D		2B		CSCLK_CR2	6B	RW		AB		ECO_TR	EB	W
LDB0_IN 2D	.DB0_FN			TMP_DR0		RW		AC			EC	†
LDB0_OU 2E RW TMP_DR3 6E RW AE EE 2F TMP_DR3 6F RW AF EF 30 70 RDIORI B0 RW FC 31 71 RDIOSYN B1 RW F1 32 72 RDIOIS B2 RW F2 33 73 RDIOLTO B3 RW F3 34 74 RDIOROO B5 RW F5 36 76 RDIOROO B5 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F9 3A 7A BA BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D FD FD		2D	RW		6D	RW		AD			ED	
2F TMP_DR3 6F RW AF EF 30 70 RDIORI B0 RW F0 31 71 RDIOSYN B1 RW F1 32 72 RDIOIS B2 RW F2 33 73 RDIOLTO B3 RW F3 34 74 RDIOROO B5 RW F4 35 75 RDIOROO B5 RW F6 36 76 RDIOROI B6 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F9 3A 7A BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FC				TMP DR2							EE	†
30											EF	
31 71 RDIOSYN B1 RW F1 32 72 RDIOIS B2 RW F2 33 73 RDIOLTO B3 RW F3 34 74 RDIOLTI B4 RW F4 35 75 RDIOROO B5 RW F5 36 76 RDIOROI B6 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F5 3A 7A BA FA 3B 7B BB F6 3C 7C BC F0 3D 7D BD F6				50			RDIORI		RW			
32 72 RDIOIS B2 RW F2 33 73 RDIOLTO B3 RW F3 34 74 RDIOLTI B4 RW F4 35 75 RDIOROO B5 RW F5 36 76 RDIOROI B6 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F5 3A 7A BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FC			 									
33 73 RDIOLTO B3 RW F3 34 74 RDIOLT1 B4 RW F4 35 75 RDIORO0 B5 RW F5 36 76 RDIORO1 B6 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F9 3A 7A BA FA 3B 7B BB FE 3C 7C BC FC 3D 7D BD FC			 									
34 74 RDIOLT1 B4 RW F4 35 75 RDIORO0 B5 RW F5 36 76 RDIORO1 B6 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F9 3A 7A BA BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FE				 		-						
35 75 RDIOROO B5 RW F5 36 76 RDIORO1 B6 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F9 3A 7A BA BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FD												<u> </u>
36 76 RDIORO1 B6 RW F6 37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F9 3A 7A BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FD												_
37 77 B7 CPU_F F7 38 78 B8 F8 39 79 B9 F9 3A 7A BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FD												ļ
38 78 B8 F8 39 79 B9 F9 3A 7A BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FD							KUIUKO1		RW		F6	
39 79 B9 F9 3A 7A BA FA 3B 7B BB BB FE 3C 7C BC FC 3D 7D BD FD	<u> </u>									CPU_F	F7	RL
3A 7A BA FA 3B 7B BB FE 3C 7C BC FC 3D 7D BD FC											F8	
3B 7B BB FE 3C 7C BC FC 3D 7D BD FC											F9	
3C 7C BC FC 3D 7D BD FD		3A						BA			FA	
3C 7C BC FC 3D 7D BD FD		3B	1		7B			BB			FB	1
3D 7D BD FD			t	1			Ì				FC	†
			†								FD	
I 3E I ■ I (E I ■ I BE I ■CPU SCR1 I FF		3E	 	1	7E		1	BE		CPU_SCR1	FE	#
			<u> </u>	1			ł — — — — — — — — — — — — — — — — — — —			CPU SCR0	FF	#
Rlank fields are Reserved and must not be accessed #Access is hit specific	Blank fields are Per		must not h	ne accessed	/ 1		# Access is hit and			o. o_oono	1 ''	π

Blank fields are Reserved and must not be accessed.

Access is bit specific.



Electrical Specifications

This section presents the DC and AC electrical specifications of the CY8C21x12 PSoC device. For the most up-to-date electrical specifications, visit the Cypress website at http://www.cypress.com.

Specifications are valid for $-40~^{\circ}\text{C} \le T_A \le 85~^{\circ}\text{C}$ and $T_J \le 100~^{\circ}\text{C}$ as specified, except where noted. Refer to Table 12 on page 18 for the electrical specifications for the IMO using slow IMO (SLIMO) mode.

Figure 5. Voltage versus CPU Frequency

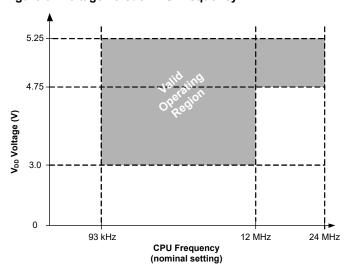
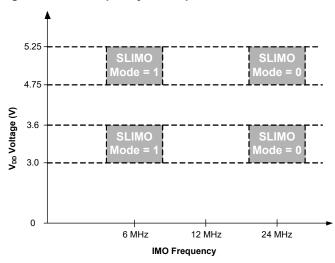


Figure 6. IMO Frequency Trim Options





Absolute Maximum Ratings

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

Symbol	Description	Min	Тур	Max	Units	Notes
T _{STG}	Storage temperature	- 55	25	+100	°C	Higher storage temperatures reduce data retention time. Recommended storage temperature is +25 °C ±25 °C. Time spent in storage at a temperature greater than 65 °C counts toward the Flash _{DR} electrical specification in Table 11 on page 17.
T _{BAKETEMP}	Bake temperature	I	125	See package label	ç	
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 _{IO}	DC input voltage	V _{SS} – 0.5	_	V _{DD} + 0.5	V	
V _{IOZ}	DC voltage applied to tri-state	V _{SS} – 0.5	_	V _{DD} + 0.5	V	
I _{MIO}	Maximum current into any port pin	-25	_	+50	mA	
ESD	Electrostatic discharge voltage	2000	_	_	V	Human Body Model ESD
LU	Latch up current	-	_	200	mA	

Operating Temperature

Symbol	Description	Min	Тур	Max	Units	Notes
T _A	Ambient temperature	-40	_	+85	°C	
TJ	Junction temperature	-40	-	+100		The temperature rise from ambient to junction is package specific. See Thermal Impedances on page 24. The user must limit the power consumption to comply with this requirement.



DC Electrical Characteristics

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 $-40 \text{ °C} \le T_A \le 85 \text{ °C}$ or 3.0 V to 3.6 V and $-40 \text{ °C} \le T_A \le 85 \text{ °C}$, respectively. Typical parameters apply to 5 V or 3.3 V at 25 °C and are for design guidance only.

Table 6. DC Chip Level Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
V_{DD}	Supply voltage	3.0	-	5.25	V	See table titled DC POR and LVD Specifications on page 16
I _{DD}	Supply current, IMO = 24 MHz	-	4	6	mA	Conditions are V _{DD} = 5.25 V, CPU = 3 MHz, 48 MHz disabled. VC1 = 1.5 MHz, VC2 = 93.75 kHz, VC3 = 0.366 kHz
I _{DD3}	Supply current, IMO = 6 MHz using SLIMO mode	-	2	4		Conditions are V_{DD} = 3.3 V, CPU = 3 MHz, 48 MHz disabled. VC1 = 375 kHz, VC2 = 23.4 kHz, VC3 = 0.091 kHz
I _{SB1}	Sleep (mode) current with POR, LVD, sleep timer, WDT, and ILO active	_	2.8	7	μΑ	V_{DD} = 3.3 V, -40 °C \leq T _A \leq 85 °C
I _{SB2}	Sleep (mode) current with POR, LVD, sleep timer, WDT, and ILO active	_	5	15	μА	$V_{DD} = 5.25 \text{ V}, -40 \text{ °C} \le T_{A} \le 85 \text{ °C}$
V_{REF}	Reference voltage (Bandgap)	1.28	1.30	1.32	V	Trimmed for appropriate V _{DD} range

DC GPIO Specifications

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

Table 7. DC GPIO Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
R _{PU}	Pull-up resistor	4	5.6	8	kΩ	
R _{PD}	Pull-down resistor	4	5.6	8	kΩ	Also applies to the internal pull-down resistor on the XRES pin
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]))
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]))
I _{OH}	High level source current	10	-	_	mA	$V_{OH} \ge V_{DD} - 1.0$ V, see the limitations of the total current in the note for V_{OH}
I _{OL}	Low level sink current	25	_	_	mA	$V_{OL} \le 0.75$ V, see the limitations of the total current in the note for V_{OL}
V _{IL}	Input low level	_	_	8.0	V	
V _{IH}	Input high level	2.1	_		V	
V_{H}	Input hysteresis	-	60	-	mV	
I _{IL}	Input leakage (absolute value)	-	1	_	nA	Gross tested to 1 μA.
C _{IN}	Capacitive load on pins as input	-	3.5	10	pF	Package and pin dependent Temp = 25 °C
C _{OUT}	Capacitive load on pins as output	_	3.5	10	pF	Package and pin dependent Temp = 25 °C

Document Number: 001-63745 Rev. *F



DC 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 $-40 \text{ °C} \le T_A \le 85 \text{ °C}$ or 3.0 V to 3.6 V and $-40 \text{ °C} \le T_A \le 85 \text{ °C}$, respectively. Typical parameters apply to 5 V or 3.3 V at 25 °C and are for design guidance only.

These comparator electrical specifications apply to the comparator in the CapSense block.

Table 8. DC Comparator Specifications

Symbol	Description	Min	Тур	Max	Units	Notes				
V _{OSCMP}	Input offset voltage (absolute value)	_	2.5	15	mV					
TCV _{OSCMP}	Average input offset voltage drift	_	10	_	μV/°C					
I _{EBCMP} ^[6]	Input leakage current (Port 0 analog pins)	_	200	_	pА	Gross tested to 1 μA				
C _{INCMP}	Input capacitance (Port 0 analog pins)	_	4.5	9.5	pF	Package and pin dependent Temp = 25 °C				
V _{CMCMP}	Common mode voltage range	0.0	_	V _{DD} – 1	V					
G _{OLCMP}	Open loop gain	_	80	_	dB					
I _{SCMP}	Supply current									
	$3.0 \text{ V} \leq \text{V}_{DD} \leq 3.6 \text{ V}$	_	30	_	μΑ					
	$4.75 \text{ V} \le \text{V}_{DD} \le 5.25 \text{ V}$	_	35	_	μΑ					

DC Analog Mux Bus Specifications

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

Table 9. DC Analog Mux Bus Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
R _{SW}	Switch resistance to common analog bus	-	_	400	Ω	
R_{VDD}	Resistance of initialization switch to V _{DD}	-	_	800	Ω	

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 $-40 \,^{\circ}\text{C} \le \text{T}_{\text{A}} \le 85 \,^{\circ}\text{C}$ or 3.0 V to 3.6 V and $-40 \,^{\circ}\text{C} \le \text{T}_{\text{A}} \le 85 \,^{\circ}\text{C}$, respectively. Typical parameters apply to 5 V or 3.3 V at $25 \,^{\circ}\text{C}$ and are for design guidance only.

Table 10. DC POR and LVD Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
V _{PPOR0} V _{PPOR1} V _{PPOR2}	V _{DD} value for precision POR (PPOR) trip PORLEV[1:0] = 00b PORLEV[1:0] = 01b PORLEV[1:0] = 10b	1 1 1	2.36 2.82 4.55	2.40 2.95 4.70	V V V	V _{DD} must be greater than or equal to 2.5 V during startup, reset from the XRES pin, or reset from watchdog.
V _{LVD1} V _{LVD2} V _{LVD3} V _{LVD4} V _{LVD5} V _{LVD6} V _{LVD7}	V _{DD} value for LVD trip VM[2:0] = 001b VM[2:0] = 010b VM[2:0] = 011b VM[2:0] = 100b VM[2:0] = 101b VM[2:0] = 110b VM[2:0] = 111b	2.85 2.95 3.06 4.37 4.50 4.62 4.71	2.92 3.02 3.13 4.48 4.64 4.73 4.81	2.99 ^[7] 3.09 3.20 4.55 4.75 4.83 4.95	V V V V V	

Notes

6. Atypical behavior: I_{EBOA} of Port 0 Pin 0 is below 1 nA at 25 °C; 50 nA over temperature. Use Port 0 Pins 1-7 for the lowest leakage of 200 pA.

Always greater than 50 mV above V_{PPOR1} (PORLEV[1:0] = 01b) for falling supply.



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 \leq $T_A \leq$ 85 °C or 3.0 V to 3.6 V and -40 °C \leq $T_A \leq$ 85 °C, respectively. Typical parameters apply to 5 V or 3.3 V at 25 °C and are for design guidance only.

Table 11. DC Programming Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
V_{DDP}	V _{DD} for programming and erase	4.5	5	5.5	V	This specification applies to the functional requirements of external programmer tools
V _{DDLV}	Low V _{DD} for verify	3.0	3.1	3.2	V	This specification applies to the functional requirements of external programmer tools
V _{DDHV}	High V _{DD} for verify	5.1	5.2	5.3	V	This specification applies to the functional requirements of external programmer tools
V _{DDIWRITE}	Supply voltage for flash write operation	3.0	-	5.25	V	This specification applies to this device when it is executing internal flash writes
I _{DDP}	Supply current during programming or verify	_	5	25	mA	
V _{ILP}	Input low voltage during programming or verify	_	_	0.8	V	
V _{IHP}	Input high voltage during programming or verify	2.2	_	_	V	
I _{ILP}	Input current when applying V _{ILP} to P1[0] or P1[1] during programming or verify	_	_	0.2	mA	Driving internal pull-down resistor
I _{IHP}	Input current when applying V _{IHP} 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	_	_	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) ^[8, 9]	1,000	_	_	_	Erase/write cycles per block
Flash _{ENT}	Flash endurance (total) ^[9, 10]	128,000	_	_	_	Erase/write cycles
Flash _{DR}	Flash data retention	15	_	_	Years	

Notes

^{8.} The erase/write cycle limit per block (Flash_{ENPB}) is only guaranteed if the device operates within one voltage range. Voltage ranges are 3.0 V to 3.6 V and 4.75 V to 5.25 V.

For the full temperature range, the user must employ a temperature sensor user module (FlashTemp) or other temperature sensor, and feed the result to the temperature argument before writing. Refer to the Flash APIs Application Note AN2015 for more information.
 The maximum total number of allowed erase/write cycles is the minimum Flash_{ENPB} value multiplied by the number of flash blocks in the device.



AC Electrical Characteristics

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 $-40~^{\circ}\text{C} \le T_{A} \le 85~^{\circ}\text{C}$ or 3.0 V to 3.6 V and $-40~^{\circ}\text{C} \le T_{A} \le 85~^{\circ}\text{C}$, respectively. Typical parameters apply to 5 V or 3.3 V at 25 $^{\circ}\text{C}$ and are for design guidance only.

Table 12. AC Chip Level Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
F _{IMO24}	IMO frequency for 24 MHz	22.8 ^[11]	24	25.2 ^[11]	MHz	Trimmed for 5 V or 3.3 V operation using factory trim values. See Figure 6 on page 13. SLIMO mode = 0.
F _{IMO6}	IMO frequency for 6 MHz	5.5 ^[11]	6	6.5 ^[11]	MHz	Trimmed for 5 V or 3.3 V operation using factory trim values. See Figure 6 on page 13. SLIMO mode = 1.
F _{CPU1}	CPU frequency (5 V V _{DD} nominal)	0.089 ^[11]	24	25.2 ^[11]	MHz	24 MHz only for SLIMO mode = 0
F _{CPU2}	CPU frequency (3.3 V V _{DD} nominal)	0.089 ^[11]	12	12.6 ^[11]	MHz	
F _{BLK5}	Digital PSoC block frequency (5 V V _{DD} nominal)	0	48	50.4 ^[11,12]	MHz	Refer to the AC Digital Block Specifications below
F _{BLK33} .	Digital PSoC block frequency (3.3 V V _{DD} nominal)	0	24	25.2 ^[11, 12]	MHz	Refer to the AC Digital Block Specifications below
F _{32K1}	ILO frequency	15	32	64	kHz	This specification applies when the ILO has been trimmed
F _{32KU}	ILO untrimmed frequency	5	-	100	kHz	After a reset and before the M8C processor starts to execute, the ILO is not trimmed.
t _{XRST}	External reset pulse width	10	_	_	μS	
DC24M	24 MHz duty cycle	40	50	60	%	
DC _{ILO}	ILO duty cycle	20	50	80	%	
Step24M	24 MHz trim step size	_	50	_	kHz	
Fout48M	48 MHz output frequency	45.6 ^[11]	48.0	50.4 ^[11]	MHz	
F _{MAX}	Maximum frequency of signal on row input or row output	_	-	12.6	MHz	
SR _{POWERUP}	Power supply slew rate	_	_	250	V/ms	V _{DD} slew rate during power-up
t _{POWERUP}	Time between end of POR state and CPU code execution	_	16	100	ms	Power-up from 0 V.
t _{JIT_IMO} ^[13]	24 MHz IMO cycle-to-cycle jitter (RMS)	-	200	700	ps	
	24 MHz IMO long term N cycle-to-cycle jitter (RMS)	_	300	900	ps	N = 32
	24 MHz IMO period jitter (RMS)	_	100	400	ps	

 ^{11.} Accuracy derived from IMO with appropriate trim for V_{DD} range.
 12. See the individual user module datasheets for information on maximum frequencies for user modules.

^{13.} Refer to Cypress Jitter Specifications application note, Understanding Datasheet Jitter Specifications for Cypress Timing Products - AN5054 for more information.



AC GPIO Specifications

The following table lists guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75 V to 5.25 V and $-40~^{\circ}\text{C} \le T_{A} \le 85~^{\circ}\text{C}$ or 3.0 V to 3.6 V and $-40~^{\circ}\text{C} \le T_{A} \le 85~^{\circ}\text{C}$, respectively. Typical parameters apply to 5 V or 3.3 V at 25 $^{\circ}\text{C}$ and are for design guidance only.

Table 13. AC GPIO Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
F _{GPIO}	GPIO operating frequency	0	_	12.6	MHz	Normal Strong Mode
TRiseF	Rise time, normal strong mode, Cload = 50 pF	2	6	18	ns	V _{DD} = 4.75 to 5.25 V, 10% to 90%
TFallF	Fall time, normal strong mode, Cload = 50 pF	2	6	18	ns	V _{DD} = 4.75 to 5.25 V, 10% to 90%
TRiseS	Rise time, slow strong mode, Cload = 50 pF	7	27	_	ns	V _{DD} = 3 to 5.25 V, 10% to 90%
TFallS	Fall time, slow strong mode, Cload = 50 pF	7	22	-	ns	V _{DD} = 3 to 5.25 V, 10% to 90%

GPIO
Pin
Output
Voltage

TRiseF
TRiseS

TFallF
TFallS

Figure 7. GPIO Timing Diagram



AC 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 $-40 \,^{\circ}\text{C} \le T_{A} \le 85 \,^{\circ}\text{C}$ or $3.0 \,^{\circ}\text{V}$ to $3.6 \,^{\circ}\text{V}$ and $-40 \,^{\circ}\text{C} \le T_{A} \le 85 \,^{\circ}\text{C}$, respectively. Typical parameters apply to $5 \,^{\circ}\text{V}$ or $3.3 \,^{\circ}\text{V}$ at $25 \,^{\circ}\text{C}$ and are for design guidance only.

These comparator electrical specifications apply to the comparator in the CapSense block.

Table 14. AC Comparator Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
t _{COMP}	Response time, 50 mV overdrive	1	75	100	ns	

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 $-40 \text{ °C} \le T_A \le 85 \text{ °C}$ or 3.0 V to 3.6 V and $-40 \text{ °C} \le T_A \le 85 \text{ °C}$, respectively. Typical parameters apply to 5 V or 3.3 V at 25 °C and are for design guidance only.

Table 15. AC Digital Block Specifications

Function	Description	Min	Тур	Max	Units	Notes
Timer	Input clock frequency					
	No capture, V _{DD} ≥ 4.75 V	_	_	50.4 ^[15]	MHz	
	No capture, V _{DD} < 4.75 V	_	_	25.2 ^[15]	MHz	
	With capture	_	_	25.2 ^[15]	MHz	
	Capture pulse width	50 ^[14]	_	_	ns	
Counter	Input clock frequency					
	No enable input, V _{DD} ≥ 4.75 V	_	_	50.4 ^[15]	MHz	
	No enable input, V _{DD} < 4.75 V	_	_	25.2 ^[15]	MHz	
	With enable input	_	_	25.2 ^[15]	MHz	
	Enable input pulse width	50 ^[14]	_	_	ns	
SPIS	Input clock (SCLK) frequency	_	-	4.2 ^[15]	MHz	The input clock is the SPI SCLK in SPIS mode.
	Width of SS_Negated between transmissions	50 ^[14]	-	_	ns	
Transmitter	Input clock frequency					The baud rate is equal to the input
	$V_{DD} \ge 4.75 \text{ V}, 2 \text{ stop bits}$	_	-	50.4 ^[15]	MHz	clock frequency divided by 8.
	$V_{DD} \ge 4.75 \text{ V}$, 1 stop bit	_	-	25.2 ^[15]	MHz	
	V _{DD} < 4.75 V	_	-	25.2 ^[15]	MHz	
Receiver	Input clock frequency					The baud rate is equal to the input
	$V_{DD} \ge 4.75 \text{ V}, 2 \text{ stop bits}$	_	-	50.4 ^[15]	MHz	clock frequency divided by 8.
	$V_{DD} \ge 4.75 \text{ V}, 1 \text{ stop bit}$	_	-	25.2 ^[15]	MHz	
	V _{DD} < 4.75 V	-	-	25.2 ^[15]	MHz	

Notes

^{14.50} ns minimum input pulse width is based on the input synchronizers running at 24 MHz (42 ns nominal period).

^{15.} Accuracy derived from IMO with appropriate trim for V_{DD} range.



AC External Clock Specifications

The following table lists guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75 V to 5.25 V and $-40 \,^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq 85 \,^{\circ}\text{C}$ or 3.0 V to 3.6 V and $-40 \,^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq 85 \,^{\circ}\text{C}$, respectively. Typical parameters apply to 5 V or 3.3 V at $25 \,^{\circ}\text{C}$ and are for design guidance only.

Table 16. 5-V AC External Clock Specifications

Symbol	Description	Min	Тур	Max	Units	Notes
F _{OSCEXT}	Frequency	0.093	_	24.6	MHz	
_	High period	20.6	_	5300	ns	
_	Low period	20.6	_	_	ns	
_	Power-up IMO to switch	150	_	-	μs	

Table 17. 3.3-V AC External Clock Specifications

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

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 $-40 \text{ °C} \le T_A \le 85 \text{ °C}$ or 3.0 V to 3.6 V and $-40 \text{ °C} \le T_A \le 85 \text{ °C}$, respectively. Typical parameters apply to 5 V or 3.3 V at 25 °C and are for design guidance only.

Table 18. AC Programming Specifications

Symbol	Description	Min	Тур	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	
t _{SCLK}	Frequency of SCLK	0	_	8	MHz	
t _{ERASEB}	Flash block erase time	_	10	40 ^[16]	ms	
t _{WRITE}	Flash block write time	_	40	160 ^[16]	ms	
t _{DSCLK}	Data out delay from falling edge of SCLK	_	38	45	ns	3.6 < V _{DD}
t _{DSCLK3}	Data out delay from falling edge of SCLK	_	44	50	ns	$3.0 \le V_{DD} \le 3.6$
t _{PRGH}	Total flash block program time (teraseb + twrite), hot	-	-	100 ^[16]	ms	T _J ≥ 0 °C
t _{PRGC}	Total flash block program time (t _{ERASEB} + t _{WRITE}), cold	_	_	200 ^[16]	ms	T _J < 0 °C

Note

Document Number: 001-63745 Rev. *F Page 21 of 38

^{16.} For the full temperature range, the user must employ a temperature sensor user module (FlashTemp) or other temperature sensor, and feed the result to the temperature argument before writing. Refer to the Flash APIs Application Note AN2015 for more information.



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 $-40~^{\circ}\text{C} \le T_{A} \le 85~^{\circ}\text{C}$ or 3.0 V to 3.6 V and $-40~^{\circ}\text{C} \le T_{A} \le 85~^{\circ}\text{C}$, respectively. Typical parameters apply to 5 V or 3.3 V at 25 $^{\circ}\text{C}$ and are for design guidance only.

Table 19. AC Characteristics of the I²C SDA and SCL Pins

Symbol	Description	Standa	rd Mode	Fast I	Mode	Units	Notes
Symbol		Min	Max	Min	Max	Units	Notes
F _{SCLI2C}	SCL clock frequency	0	100 ^[17]	0	400 ^[17]	kHz	
t _{HDSTAI2C}	Hold time (repeated) START condition. After this period, the first clock pulse is generated.	4.0	_	0.6	1	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 ^[18]	_	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	

I2C SDA T_{SUDATI2}C T_{SPI2C} $\mathsf{T}_{\mathsf{HDDATI2C}}\mathsf{T}_{\mathsf{SUSTAI2C}}$ T_{BUFI2C} T_{HDSTAI2C} 12C SCL T_{HIGHI2C} T_{LOWI2C} T_{SUSTOI2C} S STOP Condition START Condition Repeated START Condition

Figure 8. Definition for Timing for Fast/Standard Mode on the I²C Bus

^{17.} F_{SCLI2C} is derived from SysClk of the PSoC. This specification assumes that SysClk is operating at 24 MHz, nominal. If SysClk is at a lower frequency, then the F_{SCLI2C} specification adjusts accordingly

18. A Fast-Mode I²C-bus device can be used in a Standard-Mode I²C-bus system, but the requirement t_{SUDATI2C} ≥ 250 ns must then be met. This is automatically 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_{SUDATI2C} = 1000 + 250 = 1250 ns (according to the Standard-Mode I²C-bus specification) before the SCL line is released.



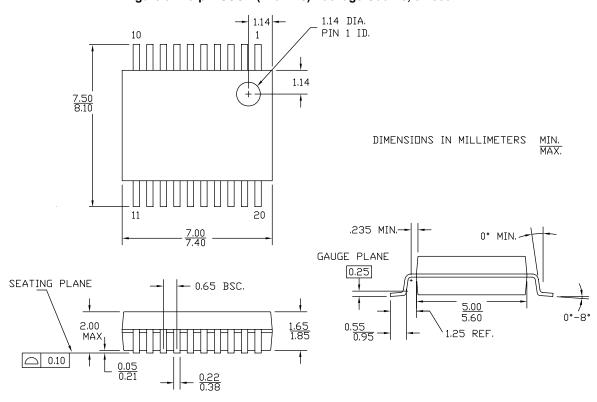
Packaging Information

This section illustrates the packaging specifications for the CY8C21x12 PSoC device, along with the thermal impedances for each package.

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 drawings at http://www.cypress.com.

Package Diagrams

Figure 9. 20-pin SSOP (210 Mils) Package Outline, 51-85077



51-85077 *F

1.14 DIA. PIN 1 ID. 1.14 7.50 8.10 DIMENSIONS IN MILLIMETERS $\frac{10.00}{10.40}$ SEATING PLANE .235 MIN.-0° MIN - 0.65 BSC. GAUGE PLANE 2.00 1.65 1.85 0.25 MAX. 0.10 5.00 5.60

Figure 10. 28-pin SSOP (210 Mils) Package Outline, 51-85079

Thermal Impedances

Table 20. Thermal Impedances per Package

Package	Typical θ _{JA} ^[19]	Typical θ _{JC}
20-Pin SSOP	117 °C/W	41 °C/W
28-Pin SSOP	96 °C/W	39 °C/W

Solder Reflow Specifications

1.25 REF-

Table 21 shows the solder reflow temperature limits that must not be exceeded.

51-85079 *F

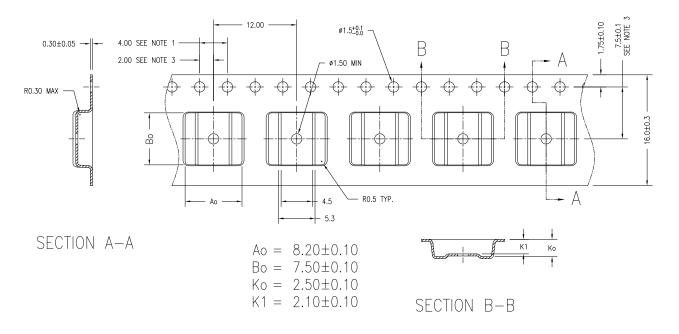
Table 21. Solder Reflow Specifications

Package	Maximum Peak Temperature (T _C)	Maximum Time above T _C – 5 °C
20-Pin SSOP	260 °C	30 seconds
28-Pin SSOP	260 °C	30 seconds



Tape and Reel Information

Figure 11. 20-Pin SSOP Carrier Tape Drawing



NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. CAMBER IN COMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE

51-51101 *C

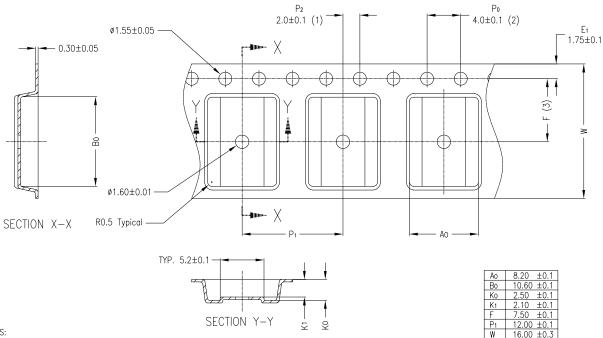


Figure 12. 28-Pin SSOP Carrier Tape Drawing

- (1) Measured from centerline of sprocket hole to centerline of pocket.
- (2) Cumulative tolerance of 10 sprocket holes is \pm 0.10.
- (3) Measured from centerline of sprocket holes is ± 0.10.

 (3) Measured from centerline of sprocket hole to centerline of pocket 4 Material: Conductive Polystyrene

 5 Camber not to exceed 1mm in 100mm

 6 Supplier P/N: SSOP28-3 CL3 22B3 Lxx W16

51-51100 *D

Table 22. Tape and Reel Specifications

Package	Cover Tape Width (mm)	Hub Size (inches)	Minimum Leading Empty Pockets	Minimum Trailing Empty Pockets	Standard Full Reel Quantity
20-Pin SSOP	13.3	4	42	25	2000
28-Pin SSOP	13.3	7	42	25	1000



Development Tool Selection

This section presents the development tools available for the CY8C21x12 family.

Software

PSoC Designer

At the core of the PSoC development software suite is PSoC Designer. Utilized by thousands of PSoC developers, this robust software has been facilitating PSoC designs for years. PSoC Designer is available free of charge at http://www.cypress.com. PSoC Designer comes with a free C compiler.

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.

Development Kits

All development kits can be purchased from the Cypress Online Store. The online store also has the most up-to-date information on kit contents, descriptions, and availability.

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 allows you to run, halt, and single step the processor, and view the contents of specific memory locations. Advanced emulation features are also supported through PSoC Designer. The kit includes:

- ICE-Cube unit
- 28-Pin PDIP emulation pod for CY8C29466-24PXI
- Two 28-Pin CY8C29466-24PXI PDIP PSoC device samples
- PSoC designer software CD
- ISSP cable
- MiniEval socket programming and evaluation board
- Backward compatibility cable (for connecting to legacy pods)
- Universal 110/220 power supply (12 V)
- European plug adapter
- USB 2.0 cable

- Getting Started guide
- Development kit registration form

CY3280-BK1

The CY3280-BK1 Universal CapSense Control Kit is designed for easy prototyping and debug of CapSense designs with pre-defined control circuitry and plug-in hardware. The kit comes with a control boards for CY8C20x34 and CY8C21x34 devices as well as a breadboard module and a button(5)/slider module.

The CY8C21x34 on-chip debugger device that is part of this kit is capable of emulating CY8C21x12 devices as well. Therefore, this kit can be used to evaluate and develop projects for CY8C21x12 devices.

Evaluation Tools

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

CY3210-PSoCEval1

The CY3210-PSoCEval1 kit features an evaluation board and the MiniProg1 programming unit. The evaluation board includes an LCD module, potentiometer, LEDs, an RS-232 port, and plenty of breadboarding space to meet all of your evaluation needs. The kit includes:

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

CY3210-21X34 Evaluation Pod (EvalPod)

The CY3210-21X34 PSoC EvalPods are pods that connect to the ICE in-circuit emulator (CY3215-DK kit) to allow debugging capability. They can also function as a standalone device without debugging capability. The EvalPod has a 28-pin DIP footprint on the bottom for easy connection to development kits or other hardware. The top of the EvalPod has prototyping headers for easy connection to the device's pins. CY3210-21X34 provides evaluation of the CY8C21x34 PSoC device family.

The CY8C21x34 on-chip debugger device that is part of this kit is capable of emulating CY8C21x12 devices as well. Therefore, this kit can be used to evaluate CY8C21x12 devices.



Device Programmers

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

CY3217-MiniProg1

The CY3217-MiniProg1 kit allows a user 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:

- MiniProg1 programmer
- USB A to Mini B cable

Accessories (Emulation and Programming)

Table 23. Emulation and Programming Accessories

- CY3217-MiniProg1 kit CD, which has kit documents, PSoC Designer and PSoC Programmer installation files
- Getting Started Guide

Part Number	Pin Package	Pod Kit ^[20]	Foot Kit ^[21]	Adapter ^[22]
CY8C21312-24PVXA	20-Pin SSOP	CY3250-21X34		Adapters are available at
CY8C21512-24PVXA	28-Pin SSOP	CY3250-21X34	CY3250-28SSOP-FK	http://www.emulation.com.

- 20. Pod kit contains an emulation pod, a flex-cable (connects the pod to the ICE), two feet, and device samples.
- 21. Foot kit includes surface mount feet that can be soldered to the target PCB.
- 22. Programming adapter converts non-DIP package to DIP footprint. Specific details and ordering information for each of the adapters are available at http://www.emulation.com.



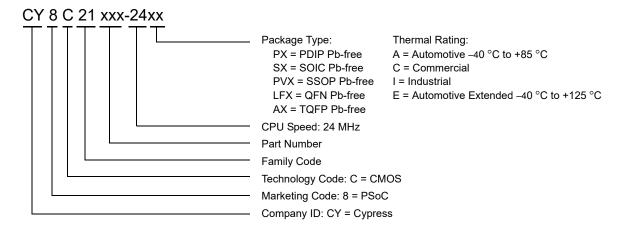
Ordering Information

The following table lists the CY8C21x12 PSoC device's key package features and ordering codes.

Table 24. PSoC Device Key Features and Ordering Information

Package	Ordering Code	Flash (Bytes)	SRAM (Bytes)	Temperature Range	Limited Digital Blocks	CapSense Blocks	Digital I/O Pins	Analog Inputs	Analog Outputs	XRES Pin
20-Pin (210-Mil) SSOP	CY8C21312-24PVXA	8K	512	–40 °C to +85 °C	1	1	16	16	0	Yes
20-Pin (210-Mil) SSOP (Tape and Reel)	CY8C21312-24PVXAT	8K	512	–40 °C to +85 °C	1	1	16	16	0	Yes
28-Pin (210-Mil) SSOP	CY8C21512-24PVXA	8K	512	–40 °C to +85 °C	1	1	24	24	0	Yes
28-Pin (210-Mil) SSOP (Tape and Reel)	CY8C21512-24PVXAT	8K	512	–40 °C to +85 °C	1	1	24	24	0	Yes

Ordering Code Definitions





Acronyms

Table 25 lists the acronyms that are used in this document.

Table 25. Acronyms Used in this Datasheet

Acronym	Description	Acronym	Description
AC	alternating current	MIPS	million instructions per second
AEC	Automotive Electronics Council	PCB	printed circuit board
ADC	analog-to-digital converter	PDIP	plastic dual in-line package
API	application programming interface	PLL	phase-locked loop
CPU	central processing unit	POR	power-on reset
CRC	cyclic redundancy check	PPOR	precision power-on reset
CSD	capsense sigma delta	PRS	pseudo-random sequence
CT	continuous time	PSoC [®]	Programmable System-on-Chip
DAC	digital-to-analog converter	PWM	pulse width modulator
DC	direct current or duty cycle	SC	switched capacitor
EEPROM	electrically erasable programmable read-only memory	SCL / SCLK	serial clock
EXTCLK	external clock	SDA	serial data
GPIO	general-purpose I/O	SLIMO	slow internal main oscillator
I ² C	Inter-Integrated Circuit	SMP	switch mode pump
ICE	in-circuit emulator	SOIC	small-outline integrated circuit
IDE	integrated development environment	SPI	serial peripheral interface
ILO	internal low-speed oscillator	SRAM	static random access memory
IMO	internal main oscillator	SROM	supervisory read-only memory
I/O	input/output	SSOP	shrink small-outline package
IrDA	Infrared Data Association	TQFP	thin quad flat pack
ISSP	in-system serial programming	UART	universal asynchronous reciever / transmitter
LCD	liquid crystal display	USB	universal serial bus
LED	light-emitting diode	WDT	watchdog timer
LVD	low voltage detect	XRES	external reset
MCU	microcontroller unit		

Reference Documents

CY8CPLC20, CY8CLED16P01, CY8C29x66, CY8C27x43, CY8C24x94, CY8C24x23, CY8C24x23A, CY8C22x13, CY8C21x34, CY8C21x23, CY7C64215, CY7C603xx, CY8CNP1xx, and CYWUSB6953 PSoC® Programmable System-on-Chip Technical Reference Manual (TRM) (001-14463)

Design Aids – Reading and Writing PSoC® Flash – AN2015 (001-40459)

Understanding Data Sheet Jitter Specifications for Cypress Timing Products – AN5054 (001-14503)



Document Conventions

Units of Measure

The following table lists the units of measure that are used in this document.

Table 26. Units of Measure

Symbol	Unit of Measure	Symbol	Unit of Measure
°C	degree Celsius	μV	microvolts
dB	decibels	mA	milliampere
KB	1024 bytes	ms	millisecond
Kbit	1024 bits	mV	millivolts
kHz	kilohertz	nA	nanoampere
kΩ	kilohm	ns	nanosecond
Mbaud	megabaud	Ω	ohm
Mbps	megabits per second	pА	picoampere
MHz	megahertz	pF	picofarad
μΑ	microampere	ps	picosecond
μs	microsecond	V	volts

Numeric Conventions

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

Glossary

active high

- 1. A logic signal having its asserted state as the logic 1 state.
- 2. A logic signal having the logic 1 state as the higher voltage of the two states.

analog blocks

The basic programmable opamp circuits. These are SC (switched capacitor) and CT (continuous time) blocks. These blocks can be interconnected to provide ADCs, DACs, multi-pole filters, gain stages, and much more.

analog-to-digital converter (ADC)

A device that changes an analog signal to a digital signal of corresponding magnitude. Typically, an ADC converts a voltage to a digital number. The digital-to-analog converter (DAC) performs the reverse operation.

Application programming interface (API)

A series of software routines that comprise an interface between a computer application and lower level services and functions (for example, user modules and libraries). APIs serve as building blocks for programmers that create software applications.

asynchronous

A signal whose data is acknowledged or acted upon immediately, irrespective of any clock signal.

bandgap reference A stable voltage reference design that matches the positive temperature coefficient of VT with the negative temperature coefficient of VBE, to produce a zero temperature coefficient (ideally) reference.

bandwidth

- 1. The frequency range of a message or information processing system measured in hertz.
- 2. The width of the spectral region over which an amplifier (or absorber) has substantial gain (or loss); it is sometimes represented more specifically as, for example, full width at half maximum.



bias

- 1. A systematic deviation of a value from a reference value.
- 2. The amount by which the average of a set of values departs from a reference value.
- 3. The electrical, mechanical, magnetic, or other force (field) applied to a device to establish a reference level to operate the device.

block

- 1. A functional unit that performs a single function, such as an oscillator.
- 2. A functional unit that may be configured to perform one of several functions, such as a digital PSoC block or an analog PSoC block.

buffer

- 1. A storage area for data that is used to compensate for a speed difference, when transferring data from one device to another. Usually refers to an area reserved for I/O operations, into which data is read, or from which data is written.
- 2. A portion of memory set aside to store data, often before it is sent to an external device or as it is received from an external device.
- 3. An amplifier used to lower the output impedance of a system.

bus

- 1. A named connection of nets. Bundling nets together in a bus makes it easier to route nets with similar routing patterns.
- A set of signals performing a common function and carrying similar data. Typically represented using vector notation; for example, address[7:0].
- 3. One or more conductors that serve as a common connection for a group of related devices.

clock

The device that generates a periodic signal with a fixed frequency and duty cycle. A clock is sometimes used to synchronize different logic blocks.

comparator

An electronic circuit that produces an output voltage or current whenever two input levels simultaneously satisfy predetermined amplitude requirements.

compiler

A program that translates a high level language, such as C, into machine language.

configuration space

In PSoC devices, the register space accessed when the XIO bit, in the CPU F register, is set to '1'.

crystal oscillator

An oscillator in which the frequency is controlled by a piezoelectric crystal. Typically a piezoelectric crystal is less sensitive to ambient temperature than other circuit components.

check (CRC)

cyclic redundancy A calculation used to detect errors in data communications, typically performed using a linear feedback shift register. Similar calculations may be used for a variety of other purposes such as data compression.

data bus

A bi-directional set of signals used by a computer to convey information from a memory location to the central processing unit and vice versa. More generally, a set of signals used to convey data between digital functions.

debugger

A hardware and software system that allows you to analyze the operation of the system under development. A debugger usually allows the developer to step through the firmware one step at a time, set break points, and

analyze memory.

dead band

A period of time when neither of two or more signals are in their active state or in transition.

digital blocks

The 8-bit logic blocks that can act as a counter, timer, serial receiver, serial transmitter, CRC generator, pseudo-random number generator, or SPI.

digital-to-analog converter (DAC) A device that changes a digital signal to an analog signal of corresponding magnitude. The analog-to-digital converter (ADC) performs the reverse operation.

Document Number: 001-63745 Rev. *F



duty cycle The relationship of a clock period high time to its low time, expressed as a percent.

emulator Duplicates (provides an emulation of) the functions of one system with a different system, so that the second

system appears to behave like the first system.

external reset (XRES)

An active high signal that is driven into the PSoC device. It causes all operation of the CPU and blocks to stop and return to a pre-defined state.

flash An electrically programmable and erasable, non-volatile technology that provides you the programmability and

data storage of EPROMs, plus in-system erasability. Non-volatile means that the data is retained when power is

The smallest amount of flash ROM space that may be programmed at one time and the smallest amount of flash flash block

space that may be protected.

The number of cycles or events per unit of time, for a periodic function. frequency

The ratio of output current, voltage, or power to input current, voltage, or power, respectively. Gain is usually gain

expressed in dB.

I²C A two-wire serial computer bus by Philips Semiconductors (now NXP Semiconductors). It is used to connect

> low-speed peripherals in an embedded system. The original system was created in the early 1980s as a battery control interface, but it was later used as a simple internal bus system for building control electronics. I2C uses only two bi-directional pins, clock and data, both running at the V_{DD} supply voltage and pulled high with resistors.

The bus operates up to 100 kbits/second in standard mode and 400 kbits/second in fast mode.

ICE The in-circuit emulator that allows you to test the project in a hardware environment, while viewing the debugging

device activity in a software environment (PSoC Designer).

input/output (I/O) A device that introduces data into or extracts data from a system.

interrupt A suspension of a process, such as the execution of a computer program, caused by an event external to that

process, and performed in such a way that the process can be resumed.

interrupt service routine (ISR)

A block of code that normal code execution is diverted to when the CPU receives a hardware interrupt. Many interrupt sources may each exist with its own priority and individual ISR code block. Each ISR code block ends with the RETI instruction, returning the device to the point in the program where it left normal program execution.

jitter

1. A misplacement of the timing of a transition from its ideal position. A typical form of corruption that occurs on serial data streams.

2. The abrupt and unwanted variations of one or more signal characteristics, such as the interval between successive pulses, the amplitude of successive cycles, or the frequency or phase of successive cycles.

low-voltage detect A circuit that senses V_{DD} and provides an interrupt to the system when V_{DD} falls below a selected threshold. (LVD)

M8C An 8-bit Harvard-architecture microprocessor. The microprocessor coordinates all activity inside a PSoC by

interfacing to the flash, SRAM, and register space.

master device A device that controls the timing for data exchanges between two devices. Or when devices are cascaded in

width, the master device is the one that controls the timing for data exchanges between the cascaded devices

and an external interface. The controlled device is called the slave device.



microcontroller An integrated circuit chip that is designed primarily for control systems and products. In addition to a CPU, a

microcontroller typically includes memory, timing circuits, and I/O circuitry. The reason for this is to permit the realization of a controller with a minimal quantity of chips, thus achieving maximal possible miniaturization. This in turn, reduces the volume and the cost of the controller. The microcontroller is normally not used for

general-purpose computation as is a microprocessor.

mixed-signal The reference to a circuit containing both analog and digital techniques and components.

modulator A device that imposes a signal on a carrier.

noise 1. A disturbance that affects a signal and that may distort the information carried by the signal.

2. The random variations of one or more characteristics of any entity such as voltage, current, or data.

oscillator A circuit that may be crystal controlled and is used to generate a clock frequency.

parity A technique for testing transmitted data. Typically, a binary digit is added to the data to make the sum of all the

digits of the binary data either always even (even parity) or always odd (odd parity).

phase-locked An electronic circuit that controls an *oscillator* so that it maintains a constant phase angle relative to a reference loop (PLL) signal.

pinouts The pin number assignment: the relation between the logical inputs and outputs of the PSoC device and their

physical counterparts in the printed circuit board (PCB) package. Pinouts involve pin numbers as a link between

schematic and PCB design (both being computer generated files) and may also involve pin names.

port A group of pins, usually eight.

power-on reset A circuit

(POR)

A circuit that forces the PSoC device to reset when the voltage is below a pre-set level. This is one type of hardware

reset.

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PSoC Designer™ The software for Cypress' Programmable System-on-Chip technology.

pulse width modulator (PWM)

An output in the form of duty cycle which varies as a function of the applied value.

RAM An acronym for random access memory. A data-storage device from which data can be read out and new data

can be written in.

register A storage device with a specific capacity, such as a bit or byte.

reset A means of bringing a system back to a known state. See hardware reset and software reset.

ROM An acronym for read only memory. A data-storage device from which data can be read out, but new data cannot

be written in.

serial 1. Pertaining to a process in which all events occur one after the other.

2. Pertaining to the sequential or consecutive occurrence of two or more related activities in a single device or

channel.

settling time The time it takes for an output signal or value to stabilize after the input has changed from one value to another.



shift register A memory storage device that sequentially shifts a word either left or right to output a stream of serial data.

slave device A device that allows another device to control the timing for data exchanges between two devices. Or when

devices are cascaded in width, the slave device is the one that allows another device to control the timing of data exchanges between the cascaded devices and an external interface. The controlling device is called the master

device.

SRAM An acronym for static random access memory. A memory device where you can store and retrieve data at a high

rate of speed. The term static is used because, after a value is loaded into an SRAM cell, it remains unchanged

until it is explicitly altered or until power is removed from the device.

SROM An acronym for supervisory read only memory. The SROM holds code that is used to boot the device, calibrate

circuitry, and perform flash operations. The functions of the SROM may be accessed in normal user code.

operating from flash.

stop bit A signal following a character or block that prepares the receiving device to receive the next character or block.

synchronous 1. A signal whose data is not acknowledged or acted upon until the next active edge of a clock signal.

2. A system whose operation is synchronized by a clock signal.

tri-state A function whose output can adopt three states: 0, 1, and Z (high-impedance). The function does not drive any

value in the Z state and, in many respects, may be considered to be disconnected from the rest of the circuit,

allowing another output to drive the same net.

UART A UART or universal asynchronous receiver-transmitter translates between parallel bits of data and serial bits.

user modules Pre-built, pre-tested hardware/firmware peripheral functions that take care of managing and configuring the lower

level analog and digital PSoC blocks. User modules also provide high level API (Application Programming

Interface) for the peripheral function.

user space The bank 0 space of the register map. The registers in this bank are more likely to be modified during normal

program execution and not just during initialization. Registers in bank 1 are most likely to be modified only during

the initialization phase of the program.

 V_{DD} A name for a power net meaning "voltage drain." The most positive power supply signal. Usually 5 V or 3.3 V.

V_{SS} A name for a power net meaning "voltage source." The most negative power supply signal.

watchdog timer A timer that must be serviced periodically. If it is not serviced, the CPU resets after a specified period of time.



Document History Page

Rev.	ECN No.	Orig. of Change	Submission Date	Description of Change
**	3023789	BTK / AESA	09/06/2010	New data sheet.
*A	3094401	BTK	11/23/2010	With reference to CDT#88767. Updated Packaging Information:
*B	3157903	BTK / NJF	01/31/2011	Added Tape and Reel Information. With reference to CDT#92832. Updated PSoC Device Characteristics: Updated Table 1. Updated Electrical Specifications: With reference to CDT#82750. Updated Absolute Maximum Ratings: Updated DC Electrical Characteristics: With reference to CDT#90944. Updated DC Electrical Characteristics: With reference to CDT#90944. Updated DC GPIO Specifications: Updated Table 7 (Added details in "Notes" column corresponding to RpD parameter). With reference to CDT#86716. Updated DC POR and LVD Specifications: Updated DC POR and LVD Specifications: Updated Table 10 (Added VpDRD parameter and its details). With reference to CDT#92822. Updated Table 11 (Added VpDRD parameter and VpDHV parameters and their details). Updated AC Electrical Characteristics: With reference to CDT#92994 and CDT#92831. Updated AC Chip Level Specifications: Updated AC Digital Block Specifications: Updated AC 12C Specifications: Updated AC 12C Specifications: Updated AC 12C Specifications: Updated Figure 8 (to improve clarity). Updated Packaging Information: With reference to CDT#92828. Updated Table 21. Updated Table 21. Updated Taple and Reel Information: Spec 51-51100 — Changed revision from *A to *B. Updated Reference Documents: Added spec 001-14503.



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Document Number: 001-63745 Rev. *F Revised March 28, 2018 Page 38 of 38



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