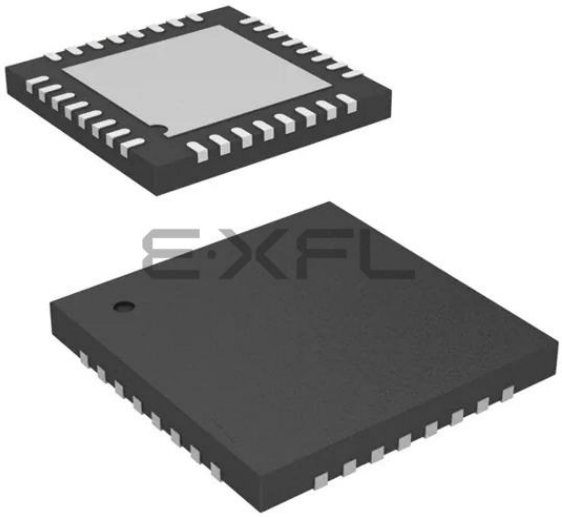

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Embedded - Microcontrollers - Application Specific: Tailored Solutions for Precision and Performance

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What Are Embedded - Microcontrollers - Application Specific?

Application-specific microcontrollers are engineered to

Details	
Product Status	Obsolete
Applications	Capacitive Sensing
Core Processor	M8C
Program Memory Type	FLASH (16kB)
Controller Series	CY8C20xx6
RAM Size	2K x 8
Interface	I²C, SPI
Number of I/O	28
Voltage - Supply	1.71V ~ 5.5V
Operating Temperature	-40°C ~ 85°C
Mounting Type	Surface Mount
Package / Case	32-UFQFN Exposed Pad
Supplier Device Package	32-QFN (5x5)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/cy8c20446-24lqxi

Additional System Resources

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

- The I2C slave/SPI master-slave module provides 50/100/400 kHz communication over two wires. SPI communication over three or four wires runs at speeds of 46.9 kHz to 3 MHz (lower for a slower system clock).
- The I2C hardware address recognition feature reduces the already low power consumption by eliminating the need for CPU intervention until a packet addressed to the target device is received.
- Low Voltage Detection (LVD) interrupts can signal the application of falling voltage levels, while the advanced POR (Power-On-Reset) circuit eliminates the need for a system supervisor.
- An internal reference provides an absolute reference for capacitive sensing.
- A register-controlled bypass mode allows the user to disable the LDO.
- Standard Cypress PSoC IDE tools are available for debugging the CY8C20x36/46/66/96 family of parts. However, the additional trace length and a minimal ground plane in the Flex-Pod can create noise problems that make it difficult to debug the design. A custom bonded On-Chip Debug (OCD) device is available in an 48-pin QFN package. The OCD device is recommended for debugging designs that have high current and/or high analog accuracy requirements. The QFN package is compact and is connected to the ICE through a high density connector.

Getting Started

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

For in depth information, along with detailed programming details, see the PSoC® Programmable System-on-Chip™ Technical Reference Manual for CY8C20x36/46/66/96 PSoC Devices.

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

Application Notes

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

Development Kits

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

Training

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

CYPros Consultants

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

Solutions Library

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

Technical Support

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

Development Tools

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

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

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

PSoC Designer Software Subsystems

System-Level View

The system-level view is a drag-and-drop visual embedded system design environment based on PSoC Express. In this view you solve design problems the same way you might think about the system. Select input and output devices based upon system requirements. Add a communication interface and define the interface to the system (registers). Define when and how an output device changes state based upon any/all other system devices. Based upon the design, PSoC Designer automatically selects one or more PSoC devices that match your system requirements.

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

Chip-Level View

The chip-level view is a more traditional integrated development environment (IDE) based on PSoC Designer 4.x. You choose a base device to work with and then select different onboard analog and digital components called user modules that use the PSoC blocks. Examples of user modules are ADCs, DACs, Amplifiers, and Filters. You configure the user modules for your chosen application and connect them to each other and to the proper pins. Then you 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 allows for changing configurations at run time.

Hybrid Designs

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

Code Generation Tools

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

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

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

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

Debugger

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 the designer to read and program and read and write data memory, read and write I/O registers, read and write CPU registers, set and clear breakpoints, and provide program run, halt, and step control. The debugger also allows the designer to create a trace buffer of registers and memory locations of interest.

Online Help System

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

In-Circuit Emulator

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

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

Designing with PSoC Designer

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

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

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

Select Components

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

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

Configure Components

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

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

Organize and Connect

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

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

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

Generate, Verify, and Debug

When you are ready to test the hardware configuration or move on to developing code for the project, 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.

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

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

The last step in the development process takes place inside 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.

Document Conventions

Acronyms Used

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

Table 1. Acronyms

Acronym	Description
AC	alternating current
API	application programming interface
CPU	central processing unit
DC	direct current
FSR	full scale range
GPIO	general purpose I/O
GUI	graphical user interface
ICE	in-circuit emulator
ILO	internal low speed oscillator
IMO	internal main oscillator
I/O	input/output
LSb	least-significant bit
LVD	low voltage detect
MSb	most-significant bit
POR	power on reset
PPOR	precision power on reset
PSoC®	Programmable System-on-Chip™
SLIMO	slow IMO
SRAM	static random access memory

Units of Measure

A units of measure table is located in the Electrical Specifications section. Table 11 on page 17 lists all the abbreviations used to measure the PSoC devices.

Numeric Naming

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

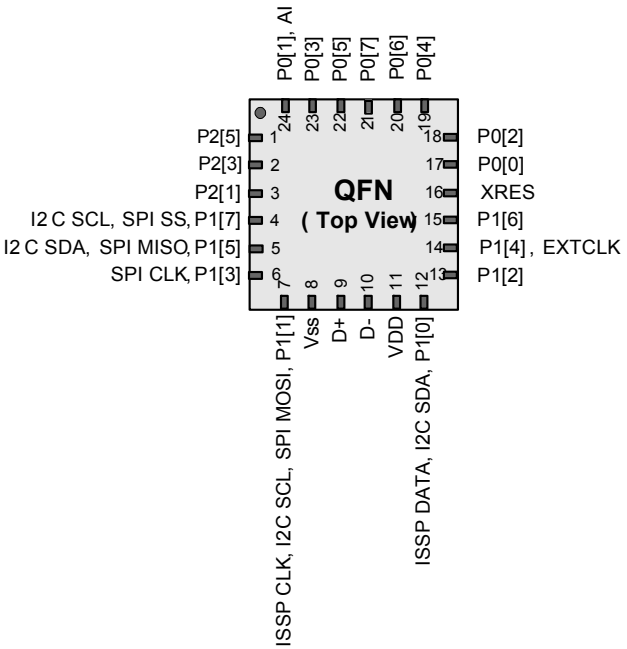
24-Pin QFN with USB

Table 4. Pin Definitions - CY8C20396 PSoC Device [2, 3]

Pin No.	Type		Name	Description
	Digital	Analog		
1	I/O	I	P2[5]	
2	I/O	I	P2[3]	
3	I/O	I	P2[1]	
4	IOHR	I	P1[7]	I2C SCL, SPI SS
5	IOHR	I	P1[5]	I2C SDA, SPI MISO
6	IOHR	I	P1[3]	SPI CLK
7	IOHR	I	P1[1]	ISSP CLK, I2C SCL, SPI MOSI
8	Power		VSS	Ground
9	I/O	I	D+	USB D+
10	I/O	I	D-	USB D-
11	Power		VDD	Supply
12	IOHR	I	P1[0]	ISSP DATA, I2C SDA
13	IOHR	I	P1[2]	
14	IOHR	I	P1[4]	Optional external clock input (EXTCLK)
15	IOHR	I	P1[6]	
16	RESET INPUT		XRES	Active high external reset with internal pull down
17	IOH	I	P0[0]	
18	IOH	I	P0[2]	
19	IOH	I	P0[4]	
20	IOH	I	P0[6]	
21	IOH	I	P0[7]	
22	IOH	I	P0[5]	
23	IOH	I	P0[3]	Integrating input
24	IOH	I	P0[1]	Integrating input
CP	Power		VSS	Thermal pad must be connected to Ground

LEGEND I = Input, O = Output, OH = 5 mA High Output Drive, R = Regulated Output

Figure 4. CY8C20396 PSoC Device



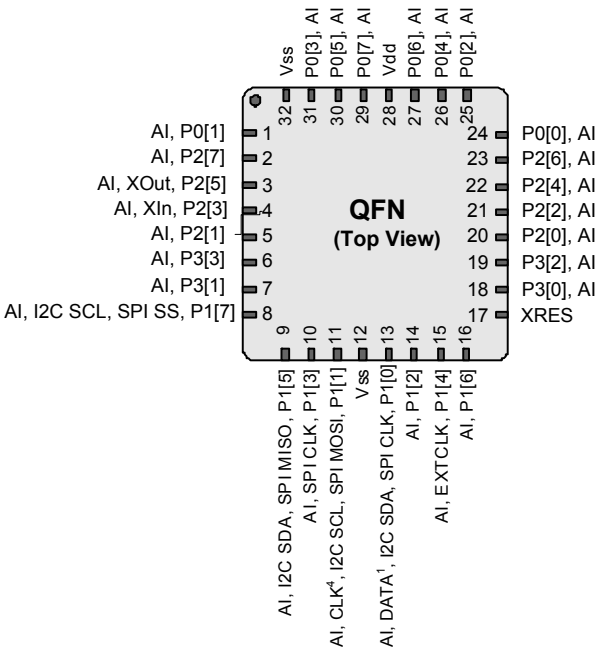
32-Pin QFN

Table 5. Pin Definitions - CY8C20436, CY8C20446, CY8C20466 PSoC Device [2, 3]

Pin No.	Type		Name	Description
	Digital	Analog		
1	IOH	I	P0[1]	Integrating input
2	I/O	I	P2[7]	
3	I/O	I	P2[5]	Crystal output (XOut)
4	I/O	I	P2[3]	Crystal input (XIn)
5	I/O	I	P2[1]	
6	I/O	I	P3[3]	
7	I/O	I	P3[1]	
8	IOHR	I	P1[7]	I2C SCL, SPI SS
9	IOHR	I	P1[5]	I2C SDA, SPI MISO
10	IOHR	I	P1[3]	SPI CLK.
11	IOHR	I	P1[1]	ISSP CLK[1], I2C SCL, SPI MOSI.
12	Power		Vss	Ground connection.
13	IOHR	I	P1[0]	ISSP DATA[1], I2C SDA., SPI CLK
14	IOHR	I	P1[2]	
15	IOHR	I	P1[4]	Optional external clock input (EXTCLK)
16	IOHR	I	P1[6]	
17	Input		XRES	Active high external reset with internal pull down
18	I/O	I	P3[0]	
19	I/O	I	P3[2]	
20	I/O	I	P2[0]	
21	I/O	I	P2[2]	
22	I/O	I	P2[4]	
23	I/O	I	P2[6]	
24	IOH	I	P0[0]	
25	IOH	I	P0[2]	
26	IOH	I	P0[4]	
27	IOH	I	P0[6]	
28	Power		Vdd	Supply voltage
29	IOH	I	P0[7]	
30	IOH	I	P0[5]	
31	IOH	I	P0[3]	Integrating input
32	Power		Vss	Ground connection
CP	Power		Vss	Center pad must be connected to ground

LEGEND A = Analog, I = Input, O = Output, OH = 5 mA High Output Drive, R = Regulated Output.

Figure 5. CY8C20436, CY8C20446, CY8C20466 PSoC Device

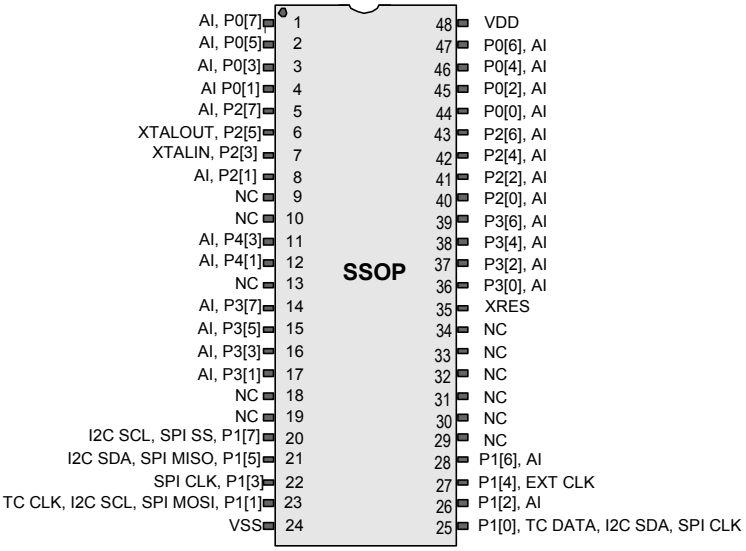


48-Pin SSOP

Table 7. Pin Definitions - CY8C20536, CY8C20546, and CY8C20566 PSoC Device[2]

Pin No.	Digital	Analog	Name	Description
1	IOH	I	P0[7]	
2	IOH	I	P0[5]	
3	IOH	I	P0[3]	
4	IOH	I	P0[1]	
5	I/O	I	P2[7]	
6	I/O	I	P2[5]	XTAL Out
7	I/O	I	P2[3]	XTAL In
8	I/O	I	P2[1]	
9			NC	No connection
10			NC	No connection
11	I/O	I	P4[3]	
12	I/O	I	P4[1]	
13			NC	No connection
14	I/O	I	P3[7]	
15	I/O	I	P3[5]	
16	I/O	I	P3[3]	
17	I/O	I	P3[1]	
18			NC	No connection
19			NC	No connection
20	IOHR	I	P1[7]	I2C SCL, SPI SS
21	IOHR	I	P1[5]	I2C SDA, SPI MISO
22	IOHR	I	P1[3]	SPI CLK
23	IOHR	I	P1[1]	TC CLK[1], I2C SCL, SPI MOSI
24			VSS	Ground Pin
25	IOHR	I	P1[0]	TC DATA[1], I2C SDA, SPI CLK
26	IOHR	I	P1[2]	
27	IOHR	I	P1[4]	EXT CLK
28	IOHR	I	P1[6]	
29			NC	No connection
30			NC	No connection
31			NC	No connection
32			NC	No connection
33			NC	No connection
34			NC	No connection
35			XRES	Active high external reset with internal pull down
36	I/O	I	P3[0]	
37	I/O	I	P3[2]	
38	I/O	I	P3[4]	
39	I/O	I	P3[6]	
40	I/O	I	P2[0]	
41	I/O	I	P2[2]	
42	I/O	I	P2[4]	
43	I/O	I	P2[6]	
44	IOH	I	P0[0]	
45	IOH	I	P0[2]	
46	IOH	I	P0[4]	
47	IOH	I	P0[6]	
48	Power		Vdd	Power Pin

Figure 6. CY8C20536, CY8C20546, and CY8C20566 PSoC Device



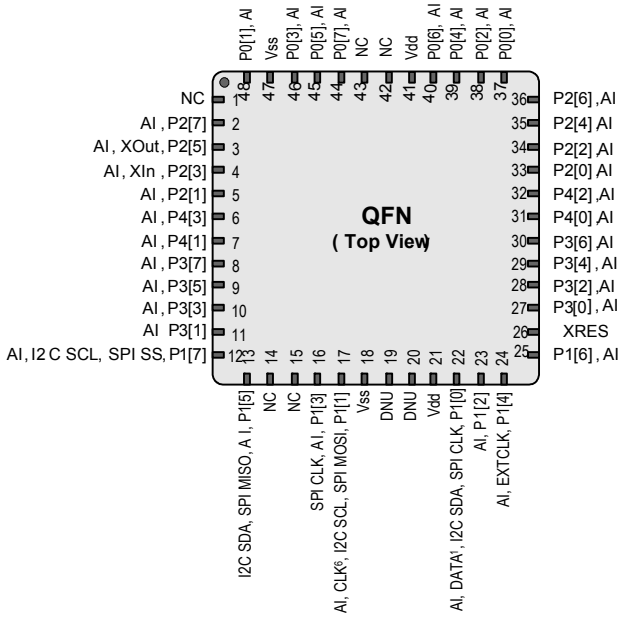
LEGEND A = Analog, I = Input, O = Output, NC = No Connection, H = 5 mA High Output Drive, R = Regulated Output Option.

48-Pin QFN

Table 8. Pin Definitions - CY8C20636 PSoC Device [2, 3]

Pin No.	Digital	Analog	Name	Description
1			NC	No connection
2	I/O	I	P2[7]	
3	I/O	I	P2[5]	Crystal output (XOut)
4	I/O	I	P2[3]	Crystal input (XIn)
5	I/O	I	P2[1]	
6	I/O	I	P4[3]	
7	I/O	I	P4[1]	
8	I/O	I	P3[7]	
9	I/O	I	P3[5]	
10	I/O	I	P3[3]	
11	I/O	I	P3[1]	
12	IOHR	I	P1[7]	I2C SCL, SPI SS
13	IOHR	I	P1[5]	I2C SDA, SPI MISO
14			NC	No connection
15			NC	No connection
16	IOHR	I	P1[3]	SPI CLK
17	IOHR	I	P1[1]	ISSP CLK[1], I2C SCL, SPI MOSI
18	Power		Vss	Ground connection
19			DNU	
20			DNU	
21	Power		Vdd	Supply voltage
22	IOHR	I	P1[0]	ISSP DATA[1], I2C SDA, SPI CLK
23	IOHR	I	P1[2]	
24	IOHR	I	P1[4]	Optional external clock input (EXTCLK)
25	IOHR	I	P1[6]	
26	Input		XRES	Active high external reset with internal pull down
27	I/O	I	P3[0]	
28	I/O	I	P3[2]	
29	I/O	I	P3[4]	
30	I/O	I	P3[6]	
31	I/O	I	P4[0]	
32	I/O	I	P4[2]	
33	I/O	I	P2[0]	
34	I/O	I	P2[2]	
35	I/O	I	P2[4]	
36	I/O	I	P2[6]	
37	IOH	I	P0[0]	
38	IOH	I	P0[2]	
39	IOH	I	P0[4]	
40	IOH	I	P0[6]	
41	Power		Vdd	Supply voltage
42			NC	No connection
43			NC	No connection
44	IOH	I	P0[7]	
45	IOH	I	P0[5]	
46	IOH	I	P0[3]	Integrating input
47	Power		Vss	Ground connection
48	IOH	I	P0[1]	
CP	Power		Vss	Center pad must be connected to ground

Figure 7. CY8C20636 PSoC Device



LEGEND A = Analog, I = Input, O = Output, NC = No Connection H = 5 mA High Output Drive, R = Regulated Output.

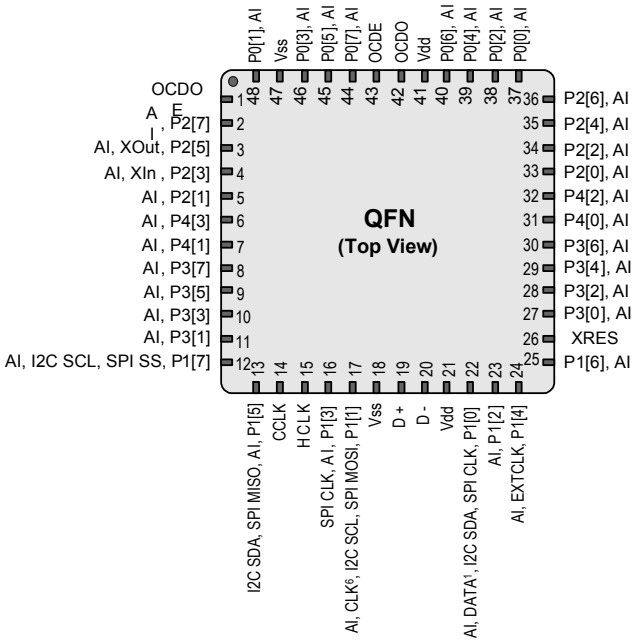
48-Pin QFN OCD

The 48-pin QFN part is for the CY8C20066 On-Chip Debug (OCD) PSoC device. Note that this part is only used for in-circuit debugging.[4]

Table 10. Pin Definitions - CY8C20066 PSoC Device [2, 3]

Pin No.	Digital	Analog	Name	Description
1			OCDOE	OCD mode direction pin
2	I/O	I	P2[7]	
3	I/O	I	P2[5]	Crystal output (XOut)
4	I/O	I	P2[3]	Crystal input (XIn)
5	I/O	I	P2[1]	
6	I/O	I	P4[3]	
7	I/O	I	P4[1]	
8	I/O	I	P3[7]	
9	I/O	I	P3[5]	
10	I/O	I	P3[3]	
11	I/O	I	P3[1]	
12	IOHR	I	P1[7]	I2C SCL, SPI SS
13	IOHR	I	P1[5]	I2C SDA, SPI MISO
14			CCLK	OCD CPU clock output
15			HCLK	OCD high speed clock output
16	IOHR	I	P1[3]	SPI CLK.
17	IOHR	I	P1[1]	ISSP CLK[1], I2C SCL, SPI MOSI
18	Power		Vss	Ground connection
19	I/O		D+	USB D+
20	I/O		D-	USB D-
21	Power		Vdd	Supply voltage
22	IOHR	I	P1[0]	ISSP DATA(1), I2C SDA, SPI CLK
23	IOHR	I	P1[2]	
24	IOHR	I	P1[4]	Optional external clock input (EXTCLK)
25	IOHR	I	P1[6]	
26	Input		XRES	Active high external reset with internal pull down
27	I/O	I	P3[0]	
28	I/O	I	P3[2]	
29	I/O	I	P3[4]	
30	I/O	I	P3[6]	
31	I/O	I	P4[0]	
32	I/O	I	P4[2]	
33	I/O	I	P2[0]	
34	I/O	I	P2[2]	
35	I/O	I	P2[4]	
36	I/O	I	P2[6]	

Figure 9. CY8C20066 PSoC Device



Pin No.	Digital	Analog	Name	Description
37	IOH	I	P0[0]	
38	IOH	I	P0[2]	
39	IOH	I	P0[4]	
40	IOH	I	P0[6]	
41	Power		Vdd	Supply voltage
42			OCDO	OCD even data I/O
43			OCDE	OCD odd data output
44	IOH	I	P0[7]	
45	IOH	I	P0[5]	
46	IOH	I	P0[3]	Integrating input
47	Power		Vss	Ground connection
48	IOH	I	P0[1]	
CP	Power		Vss	Center pad must be connected to ground

LEGEND A = Analog, I = Input, O = Output, NC = No Connection H = 5 mA High Output Drive, R = Regulated Output.

Note
4. This part is available in limited quantities for In-Circuit Debugging during prototype development. It is not available in production volumes.

Absolute Maximum Ratings

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

Table 12. Absolute Maximum Ratings

Symbol	Description	Conditions	Min	Typ	Max	Units
T_{STG}	Storage Temperature	Higher storage temperatures reduces data retention time. Recommended Storage Temperature is +25°C ± 25°C. Extended duration storage temperatures above 85°C degrades reliability.	–55	+25	+125	°C
Vdd	Supply Voltage Relative to Vss		–0.5	–	+6.0	V
V_{IO}	DC Input Voltage		Vss – 0.5	–	Vdd + 0.5	V
V_{IOZ}	DC Voltage Applied to Tri-state		Vss –0.5	–	Vdd + 0.5	V
I_{MIO}	Maximum Current into any Port Pin		–25	–	+50	mA
ESD	Electro Static Discharge Voltage	Human Body Model ESD	2000	–	–	V
LU	Latch up Current	In accordance with JESD78 standard	–	–	200	mA

Operating Temperature

Table 13. Operating Temperature

Symbol	Description	Conditions	Min	Typ	Max	Units
T_A	Ambient Temperature		–40	–	+85	°C
T_J	Operational Die Temperature	The temperature rise from ambient to junction is package specific. Refer the table Thermal Impedances per Package on page 34. The user must limit the power consumption to comply with this requirement.	–40	–	+100	°C

Table 15. 3.0V to 5.5V DC GPIO Specifications *(continued)*

Symbol	Description	Conditions	Min	Typ	Max	Units
V_{OH10}	High Output Voltage Port 1 Pins with LDO Enabled for 1.8V Out	IOH = 1 mA, Vdd > 2.7V, maximum of 20 mA source current in all IOs	1.20	–	–	V
V_{OL}	Low Output Voltage	IOL = 25 mA, Vdd > 3.3V, maximum of 60 mA sink current on even port pins (for example, P0[2] and P1[4]) and 60 mA sink current on odd port pins (for example, P0[3] and P1[5])	–	–	0.75	V
V_{IL}	Input Low Voltage		–	–	0.80	V
V_{IH}	Input High Voltage		2.00	–		V
V_H	Input Hysteresis Voltage		–	80	–	mV
I_{IL}	Input Leakage (Absolute Value)		–	0.001	1	µA
C_{PIN}	Pin Capacitance	Package and pin dependent Temp = 25°C	0.5	1.7	5	pF

Table 17. 1.71V to 2.4V DC GPIO Specifications *(continued)*

Symbol	Description	Conditions	Min	Typ	Max	Units
V_H	Input Hysteresis Voltage		–	80	–	mV
I_{IL}	Input Leakage (Absolute Value)		–	0.001	1	µA
C_{PIN}	Capacitive Load on Pins	Package and pin dependent Temp = 25°C	0.5	1.7	5	pF

Table 18.DC Characteristics – USB Interface

Symbol	Description	Conditions	Min	Typ	Max	Units
Rusbi	USB D+ Pull Up Resistance	With idle bus	0.900	-	1.575	kΩ
Rusba	USB D+ Pull Up Resistance	While receiving traffic	1.425	-	3.090	kΩ
Vohusb	Static Output High		2.8	-	3.6	V
Volusb	Static Output Low			-	0.3	V
Vdi	Differential Input Sensitivity		0.2	-		V
Vcm	Differential Input Common Mode Range		0.8	-	2.5	V
Vse	Single Ended Receiver Threshold		0.8	-	2.0	V
Cin	Transceiver Capacitance			-	50	pF
Iio	Hi-Z State Data Line Leakage	On D+ or D- line	-10	-	+10	µA
Rps2	PS/2 Pull Up Resistance		3	5	7	kΩ
Rext	External USB Series Resistor	In series with each USB pin	21.78	22.0	22.22	Ω

DC Analog Mux Bus Specifications

The following table lists guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 19. DC Analog Mux Bus Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
R_{SW}	Switch Resistance to Common Analog Bus		–	–	800	Ω
R_{GND}	Resistance of Initialization Switch to Vss		–	–	800	Ω

The maximum pin voltage for measuring R_{SW} and R_{GND} is 1.8V

DC Low Power Comparator Specifications

The following table lists guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 20. DC Comparator Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
V_{LPC}	Low Power Comparator (LPC) common mode	Maximum voltage limited to Vdd	0.0	–	1.8	V
I_{LPC}	LPC supply current		–	10	40	µA
V_{OSLPC}	LPC voltage offset		–	2.5	30	mV

Comparator User Module Electrical Specifications

The following table lists the guaranteed maximum and minimum specifications. Unless stated otherwise, the specifications are for the entire device voltage and temperature operating range: –40°C <= TA <= 85°C, 1.71V <= Vdd <= 5.5V.

Table 21. Comparator User Module Electrical Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
T_{COMP}	Comparator Response Time	50 mV overdrive		70	100	ns
Offset				2.5	30	mV
Current		Average DC current, 50 mV overdrive		20	80	µA
PSRR	Supply voltage >2V	Power Supply Rejection Ratio		80		dB
	Supply voltage <2V	Power Supply Rejection Ratio		40		dB
Input Range			0		1.5	V

ADC Electrical Specifications

Table 22. ADC User Module Electrical Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
Input						
V_{IN}	Input Voltage Range	This gives 72% of maximum code	Vss		1.3	V
C_{IN}	Input Capacitance				5	pF
RES	Resolution	Settings 8, 9, or 10	8		10	Bits
S8	8-Bit Sample Rate	Data Clock set to 6 MHz. Sample Rate = 0.001/ (2^Resolution/Data clock)		23.4375		ksps
S10	10-Bit Sample Rate	Data Clock set to 6 MHz. Sample Rate = 0.001/ (2^Resolution/Data clock)		5.859		ksps
DC Accuracy						
DNL[5]	Differential Nonlinearity	For any configuration	-1		+2	LSB
INL	Integral Nonlinearity	For any configuration	-2		+2	LSB
Eoffset	Offset Error		0	15	90	mV
I_{ADC}	Operating Current			275	350	µA
F_{CLK}	Data Clock	Source is chip's internal main oscillator. See device data sheet for accuracy.	2.25		12	MHz
PSRR	Power Supply Rejection Ration					
	PSRR (Vdd>3.0V)			24	dB	
	PSRR (2.2 < Vdd < 3.0)			30	dB	
	PSRR (2.0 < Vdd < 2.2)			12	dB	
	PSRR (Vdd < 2.0)			0	dB	
Egain	Gain Error	For any resolution	1		5	%FSR
R_{IN}	Input Resistance	Equivalent switched cap input resistance for 8-, 9-, or 10-bit resolution.	1/(500fF* Data-Clock)	1/(400fF* Data-Clock)	1/(300fF* Data-Clock)	Ω

Note
5. Monotonicity is not guaranteed.

Table 27.AC Characteristics – USB Data Timings

Symbol	Description	Conditions	Min	Typ	Max	Units
Tdrate	Full speed data rate	Average bit rate	12–0.25%	12	12 + 0.25%	MHz
Tdjr1	Receiver data jitter tolerance	To next transition	-18.5	–	18.5	ns
Tdjr2	Receiver data jitter tolerance	To pair transition	-9	–	9	ns
Tudj1	Driver differential jitter	To next transition	-3.5	–	3.5	ns
Tudj2	Driver differential jitter	To pair transition	-4.0	–	4.0	ns
Tfdeop	Source jitter for differential transition	To SE0 transition	-2	–	5	ns
Tfeopt	Source SE0 interval of EOP		160	–	175	ns
Tfeopr	Receiver SE0 interval of EOP		82	–		ns
Tfst	Width of SE0 interval during differential transition			–	14	ns

Table 28.AC Characteristics – USB Driver

Symbol	Description	Conditions	Min	Typ	Max	Units
Tr	Transition rise time	50 pF	4	–	20	ns
Tf	Transition fall time	50 pF	4	–	20	ns
TR	Rise/fall time matching		90.00	–	111.1	%
Vcrs	Output signal crossover voltage		1.3	–	2.0	V

AC Comparator Specifications

The following table lists guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 29. AC Low Power Comparator Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
T_{LPC}	Comparator Response Time, 50 mV Overdrive	50 mV overdrive does not include offset voltage.			100	ns

AC Analog Mux Bus Specifications

The following table lists guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 30. AC Analog Mux Bus Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
F_{SW}	Switch Rate	Maximum pin voltage when measuring switch rate is 1.8Vp-p	–	–	6.3	MHz

AC External Clock Specifications

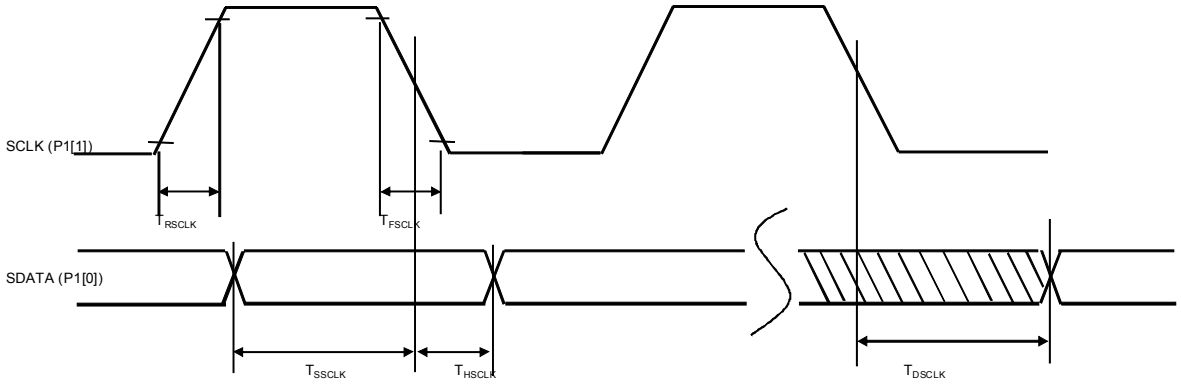
The following table lists guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 31. AC External Clock Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
F_{OSCEXT}	Frequency		0.750	–	25.2	MHz
–	High Period		20.6	–	5300	ns
–	Low Period		20.6	–	–	ns
–	Power Up IMO to Switch		150	–	–	µs

AC Programming Specifications

Figure 13. AC Waveform



The following table lists the guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 32. AC Programming Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
T_{RSCLK}	Rise Time of SCLK		1	–	20	ns
T_{FSCLK}	Fall Time of SCLK		1	–	20	ns
T_{SSCLK}	Data Set up Time to Falling Edge of SCLK		40	–	–	ns
T_{HSCLK}	Data Hold Time from Falling Edge of SCLK		40	–	–	ns
F_{SCLK}	Frequency of SCLK		0	–	8	MHz
T_{ERASEB}	Flash Erase Time (Block)		–	–	18	ms
T_{WRITE}	Flash Block Write Time		–	–	25	ms
T_{DSCLK}	Data Out Delay from Falling Edge of SCLK	3.6 < Vdd	–	–	60	ns
T_{DSCLK3}	Data Out Delay from Falling Edge of SCLK	3.0 ≤ Vdd ≤ 3.6	–	–	85	ns
T_{DSCLK2}	Data Out Delay from Falling Edge of SCLK	1.71 ≤ Vdd ≤ 3.0	–	–	130	ns
T_{XRST3}	External Reset Pulse Width after Power Up	Required to enter programming mode when coming out of sleep	263	–	–	µs

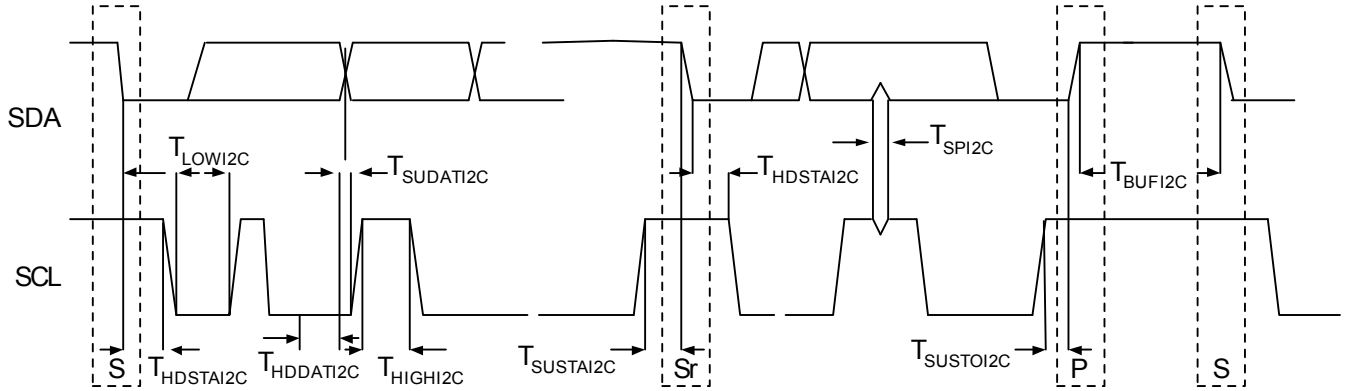
AC I2C Specifications

The following table lists guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 33. AC Characteristics of the I2C SDA and SCL Pins

Symbol	Description	Standard Mode		Fast Mode		Units
		Min	Max	Min	Max	
F_{SCLI2C}	SCL Clock Frequency	0	100	0	400	kHz
$T_{HDSTAI2C}$	Hold Time (repeated) START Condition. After this period, the first clock pulse is generated.	4.0	–	0.6	–	µs
T_{LOWI2C}	LOW Period of the SCL Clock	4.7	–	1.3	–	µs
$T_{HIGHI2C}$	HIGH Period of the SCL Clock	4.0	–	0.6	–	µs
$T_{SUSTAI2C}$	Setup Time for a Repeated START Condition	4.7	–	0.6	–	µs
$T_{HDDATI2C}$	Data Hold Time	0	–	0	–	µs
$T_{SUDATI2C}$	Data Setup Time	250	–	100[11]	–	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 14. Definition for Timing for Fast/Standard Mode on the I^2C Bus



Note

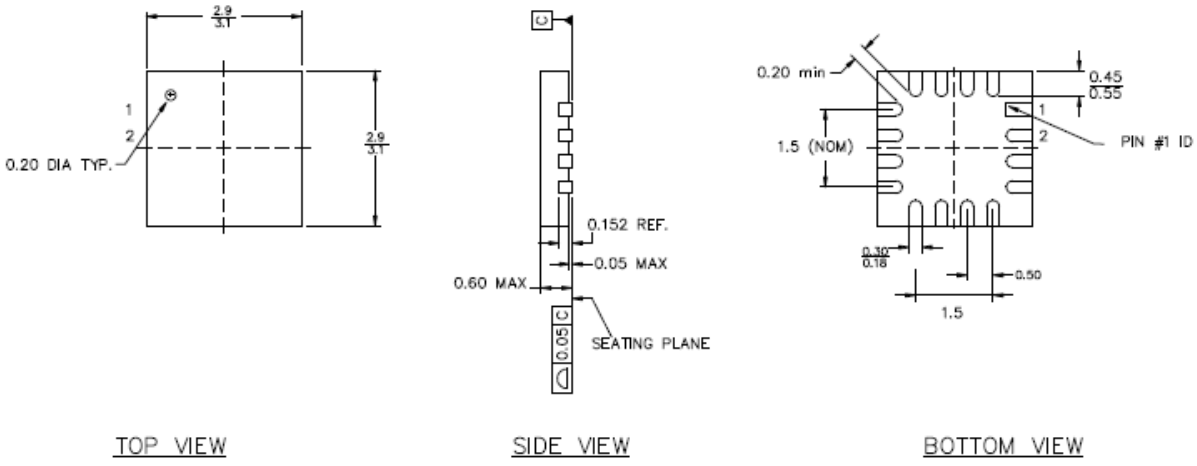
11. A Fast-Mode I2C-bus device can be used in a Standard Mode I2C-bus system, but the requirement $t_{SU;DAT} \geq 250$ ns must then be met. This automatically be the case if the device does not stretch the LOW period of the SCL signal. If such device does stretch the LOW period of the SCL signal, it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

Packaging Information

This section illustrates the packaging specifications for the CY8C20x36/46/66/96 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 document titled *PSoC Emulator Pod Dimensions* at http://www.cypress.com/design/MR10161.

Figure 15. 16-pin QFN No E-pad 3x3mm Package Outline (Sawn)



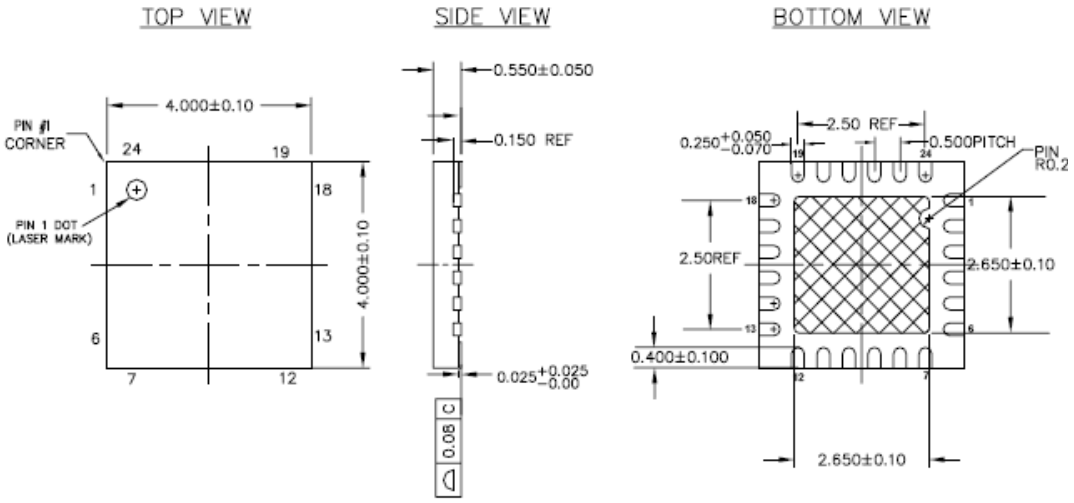
PART NO.	DESCRIPTION
LG16A	LEAD-FREE
LD16A	STANDARD

NOTES:

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

001-09116 *D

Figure 16. 24-Pin (4x4 x 0.6 mm) QFN

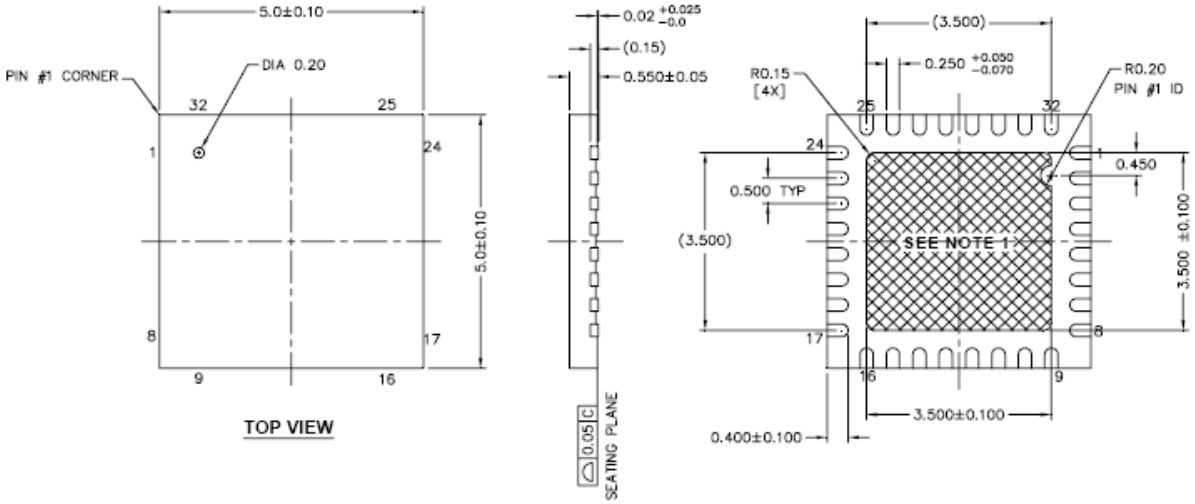


NOTES :

1. HATCH IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC # MO-248
3. UNIT PACKAGE WEIGHT : 0.024 grams
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-13937 *B

Figure 17. 32-Pin (5x5 x 0.6 mm) QFN



TOP VIEW

SIDE VIEW

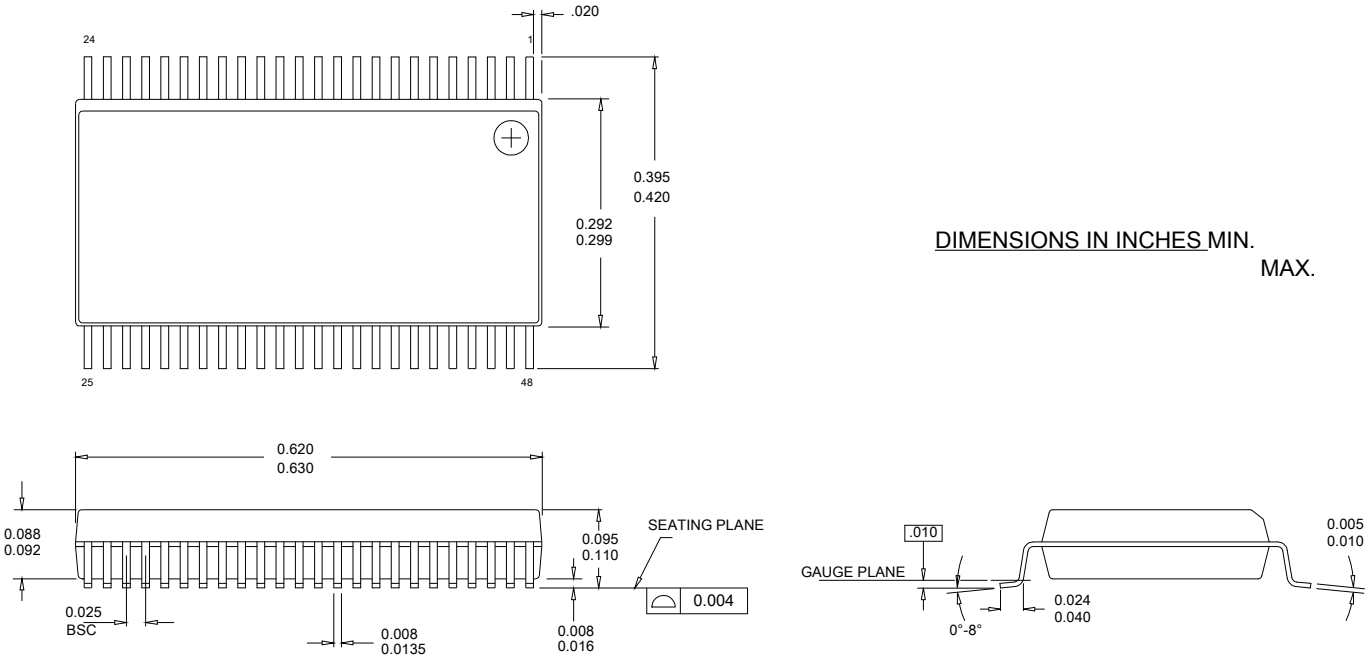
BOTTOM VIEW

NOTES:

1. HATCH AREA IS SOLDERABLE EXPOSED PAD
2. BASED ON REF JEDEC # MO-248
3. PACKAGE WEIGHT: 0.0388g
4. DIMENSIONS ARE IN MILLIMETERS

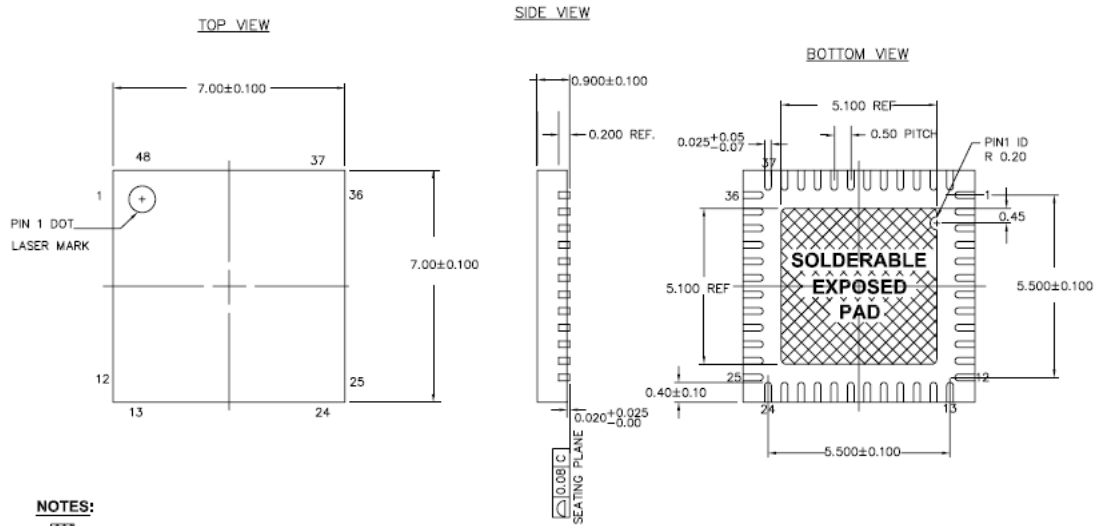
001-42168 *C

Figure 18. 48-Pin (300 MIL) SSOP



51-85061 *C

Figure 19. 48-Pin (7x7 mm) QFN



NOTES:
1. HATCH AREA IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.13g
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-13191 *C

Important Notes

- For information on the preferred dimensions for mounting QFN packages, see the following Application Note at http://www.amkor.com/products/notes_papers/MLFAppNote.pdf.
- Pinned vias for thermal conduction are not required for the low power PSoC device.

Ordering Information

The following table lists the CY8C20x36/46/66/96 PSoC devices' key package features and ordering codes.

Table 39. PSoC Device Key Features and Ordering Information

Package	Ordering Code	Flash (Bytes)	SRAM (Bytes)	CapSense Blocks	Digital I/O Pins	Analog Inputs[18]	XRES Pin	USB
16-Pin (3x3x0.6mm) QFN	CY8C20236-24LKXI	8K	1K	1	13	13	Yes	No
16-Pin (3x3x0.6mm) QFN (Tape and Reel)	CY8C20236-24LKXIT	8K	1K	1	13	13	Yes	No
16 Pin (3x3 x 0.6 mm) QFN	CY8C20246-24LKXI	16K	2K	1	13	13	Yes	No
16 Pin (3x3 x 0.6 mm) QFN (Tape and Reel)	CY8C20246-24LKXIT	16K	2K	1	13	13	Yes	No
24-Pin (4x4x0.6mm) QFN	CY8C20336-24LQXI	8K	1K	1	20	20	Yes	No
24-Pin (4x4x0.6mm) QFN (Tape and Reel)	CY8C20336-24LQXIT	8K	1K	1	20	20	Yes	No
24 Pin (4x4 x 0.6 mm) QFN	CY8C20346-24LQXI	16K	2K	1	20	20	Yes	No
24 Pin (4x4 x 0.6 mm) QFN (Tape and Reel)	CY8C20346-24LQXIT	16K	2K	1	20	20	Yes	No
24-Pin (4x4x0.6mm) QFN	CY8C20396-24LQXI	16K	2K	1	19	19	Yes	Yes
24-Pin (4x4x0.6mm) QFN (Tape and Reel)	CY8C20396-24LQXIT	16K	2K	1	19	19	Yes	Yes
32-Pin (5x5x0.6mm) QFN	CY8C20436-24LQXI	8K	1K	1	28	28	Yes	No
32-Pin (5x5x0.6mm) QFN (Tape and Reel)	CY8C20436-24LQXIT	8K	1K	1	28	28	Yes	No
32 Pin (5x5 x 0.6 mm) QFN	CY8C20446-24LQXI	16K	2K	1	28	28	Yes	No
32 Pin (5x5 x 0.6 mm) QFN (Tape and Reel)	CY8C20446-24LQXIT	16K	2K	1	28	28	Yes	No
32 Pin (5x5 x 0.6 mm) QFN	CY8C20466-24LQXI	32K	2K	1	28	28	Yes	No
32 Pin (5x5 x 0.6 mm) QFN (Tape and Reel)	CY8C20466-24LQXIT	32K	2K	1	28	28	Yes	No
32 Pin (5x5 x 0.6 mm) QFN	CY8C20496-24LQXI	16K	2K	1	25	25	Yes	No
32 Pin (5x5 x 0.6 mm) QFN (Tape and Reel)	CY8C20496-24LQXIT	16K	2K	1	25	25	Yes	No
48-Pin SSOP	CY8C20536-24PVXI	8K	1K	1	36	36	Yes	No
48-Pin SSOP (Tape and Reel)	CY8C20536-24PVXIT	8K	1K	1	36	36	Yes	No
48-Pin SSOP	CY8C20546-24PVXI	16K	2K	1	36	36	Yes	No
48-Pin SSOP (Tape and Reel)	CY8C20546-24PVXIT	16K	2K	1	36	36	Yes	No
48-Pin SSOP	CY8C20566-24PVXI	32K	2K	1	36	36	Yes	No
48-Pin SSOP (Tape and Reel)	CY8C20566-24PVXIT	32K	2K	1	36	36	Yes	No
48 Pin (7x7 mm) QFN	CY8C20636-24LTXI	8K	1K	1	36	36	Yes	No
48 Pin (7x7 mm) QFN (Tape and Reel)	CY8C20636-24LTXIT	8K	1K	1	36	36	Yes	No
48 Pin (7x7 mm) QFN	CY8C20646-24LTXI	16K	2K	1	36	36	Yes	Yes
48 Pin (7x7 mm) QFN (Tape and Reel)	CY8C20646-24LTXIT	16K	2K	1	36	36	Yes	Yes
48 Pin (7x7 mm) QFN	CY8C20666-24LTXI	32K	2K	1	36	36	Yes	Yes
48 Pin (7x7 mm) QFN (Tape and Reel)	CY8C20666-24LTXIT	32K	2K	1	36	36	Yes	Yes
48 Pin (7x7 mm) QFN (OCD)[4]	CY8C20066-24LTXI	32K	2K	1	36	36	Yes	Yes

Notes
18. Dual-function Digital I/O Pins also connect to the common analog mux.