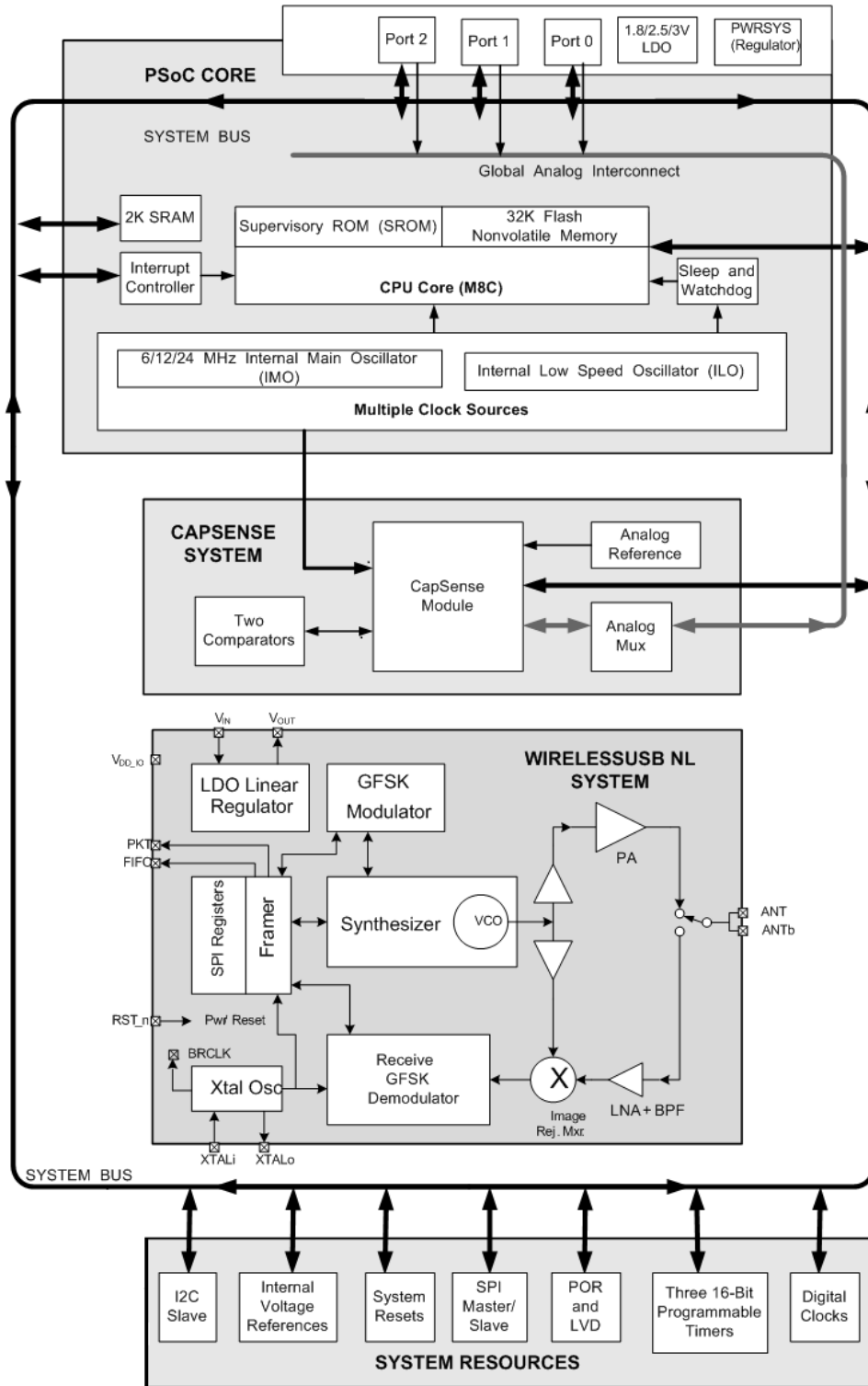


PRoC-CS Features

- Single Device, Two functions
 - 8-bit flash based capacitive touch controller MCU function and 2.4-GHz WirelessUSB™ NL radio transceiver function in a single device
- Wide operating range: 1.9 V to 3.6 V
 - Configurable capacitive sensing elements
 - 7 μ A per sensor at 500 ms scan rate
 - Supports SmartSense™ Auto-tuning
 - Supports a combination of CapSense® buttons, sliders, touchpads, touchscreens, and proximity sensors
 - SmartSense_EMC offers superior noise immunity for applications with challenging conducted and radiated noise conditions
 - 2.4-GHz WirelessUSB NL Transceiver function
 - Operates in the 2.4-GHz ISM Band (2.402 GHz - 2.479 GHz)
 - 1-Mbps over-the-air data rate
 - Receive sensitivity typical: -87 dBm
 - Below 1 μ A typical current consumption in sleep state
 - Closed-loop frequency synthesis
 - Supports frequency-hopping spread spectrum
 - On-chip packet framer with 64-byte first in first out (FIFO) data buffer
 - Built-in auto-retry-acknowledge protocol simplifies usage
 - Built-in cyclic redundancy check (CRC), forward error correction (FEC), data whitening
 - Additional outputs for interrupt request (IRQ) generation
 - Digital readout of received signal strength indication (RSSI)
- Powerful Harvard-architecture processor
 - M8C CPU – Up to 4 MIPS with 24 MHz Internal clock, external crystal resonator or clock signal
 - Low power at high speed
- Temperature range: 0 °C to +70 °C
- Flexible on-chip memory
 - 32 KB Flash/2 KB SRAM
 - 50,000 flash erase/write cycles
 - Partial flash updates
 - Flexible protection modes
 - In-system serial programming (ISSP)
- Precision, programmable clocking
 - Internal main oscillator (IMO): 6/12/24 MHz \pm 5%
 - Internal low-speed oscillator (ILO) at 32 kHz for watchdog and sleep timers
 - Precision 32 kHz oscillator for optional external crystal
- Programmable pin configurations
 - Up to 13 general-purpose I/Os (GPIOs)
 - Dual mode GPIO: All GPIOs support digital I/O and analog inputs
 - 25-mA sink current on each GPIO
 - 120 mA total sink current on all GPIOs
 - Pull-up, high Z, open-drain modes on all GPIOs
 - CMOS drive mode -5 mA source current on ports 0 and 1 and 1 mA on port 2
 - 20 mA total source current on all GPIOs
- Versatile analog system
 - Low-dropout voltage regulator for all analog resources
 - Common internal analog bus enabling capacitive sensing on all pins
 - High power supply rejection ratio (PSRR) comparator
 - 8 to 10-bit incremental analog-to-digital converter (ADC)
- Additional system resources
 - I²C slave:
 - Selectable to 50 kHz, 100 kHz, or 400 kHz
 - SPI master and slave: Configurable 46.9 kHz to 12 MHz
 - Three 16-bit timers
 - Watchdog and sleep timers
 - Integrated supervisory circuit
 - Emulated E2PROM using flash memory
- Complete development tools
 - Free development tool (PSoC Designer™)
 - Full-featured, in-circuit emulator (ICE) and programmer
 - Full-speed emulation
 - Complex breakpoint structure
 - 128 KB trace memory
- Package option
 - 40-pin 6 mm \times 6 mm QFN

Logical Block Diagram



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PSoC[®] Functional Overview

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

The architecture for this device family, as shown in the [Logical Block Diagram on page 2](#), consists of three main areas:

- The Core
- CapSense Analog System
- WirelessUSB NL System
- System Resources.

A common, versatile bus allows connection between I/O and the analog system.

Each CYRF89435 device includes a dedicated CapSense block that provides sensing and scanning control circuitry for capacitive sensing applications. The 13 GPIOs provide access to the MCU and analog mux.

PSoC Core

The PSoC Core is a powerful engine that supports a rich instruction set. It encompasses SRAM for data storage, an interrupt controller, sleep and watchdog timers, and IMO and ILO. The CPU core, called the M8C, is a powerful processor with speeds up to 24 MHz. The M8C is a 4-MIPS, 8-bit Harvard-architecture microprocessor.

CapSense System

The analog system contains the capacitive sensing hardware. Several hardware algorithms are supported. This hardware performs capacitive sensing and scanning without requiring external components. The analog system is composed of the CapSense PSoC block and an internal 1 V or 1.2 V analog reference, which together support capacitive sensing of up to 13 inputs. Capacitive sensing is configurable on each GPIO pin. Scanning of enabled CapSense pins are completed quickly and easily across multiple ports.

SmartSense

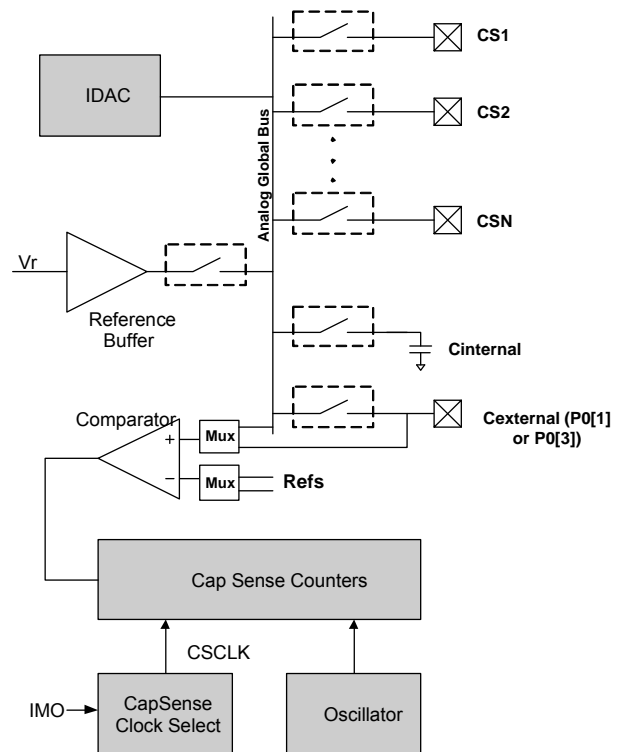
SmartSense is an innovative solution from Cypress that removes manual tuning of CapSense applications. This solution is easy to use and provides a robust noise immunity. It is the only auto-tuning solution that establishes, monitors, and maintains all required tuning parameters. SmartSense allows engineers to go

from prototyping to mass production without re-tuning for manufacturing variations in PCB and/or overlay material properties.

SmartSense_EMC

In addition to the SmartSense applications, SmartSense_EMC user module incorporates a unique algorithm to improve robustness of capacitive sensing algorithm/circuit against high frequency conducted and radiated noise. Every electronic device must comply with specific limits for radiated and conducted external noise and these limits are specified by regulatory bodies (for example, FCC, CE, U/L and so on). A very good PCB layout design, power supply design and system design is a mandatory for a product to pass the conducted and radiated noise tests. An ideal PCB layout, power supply design or system design is not often possible because of cost and form factor limitations of the product. SmartSense_EMC with superior noise immunity is well suited and handy for such applications to pass radiated and conducted noise test.

Figure 1. CapSense System Block Diagram



Analog Multiplexer System

The Analog Mux Bus can connect to every GPIO pin. Pins are connected to the bus individually or in any combination. The bus also connects to the analog system for analysis with the CapSense block comparator.

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:

- Complex capacitive sensing interfaces, such as sliders and touchpads.
- Chip-wide mux that allows analog input from any I/O pin.
- Crosspoint connection between any I/O pin combinations.

WirelessUSB NL System

WirelessUSB NL, optimized to operate in the 2.4-GHz ISM band, is Cypress's third generation of 2.4-GHz low-power RF technology. WirelessUSB NL implements a Gaussian frequency-shift keying (GFSK) radio using a differentiated single-mixer, closed-loop modulation design that optimizes power efficiency and interference immunity. Closed-loop modulation effectively eliminates the problem of frequency drift, enabling WirelessUSB NL to transmit up to 255-byte payloads without repeatedly having to pay power penalties for re-locking the phase-locked loop (PLL) as in open-loop designs

Among the advantages of WirelessUSB NL are its fast lock times and channel switching, along with the ability to transmit larger payloads. Use of longer payload packets, compared to multiple short payload packets, can reduce overhead, improve overall power efficiency, and help alleviate spectrum crowding.

Combined with Cypress's Capacitive touch sense controllers, WirelessUSB NL also provides the lowest bill of materials (BOM) cost solution for sophisticated PC peripheral applications such as wireless keyboards and mice, as well as best-in-class wireless performance in other demanding applications. such as toys, remote controls, fitness, automation, presenter tools, and gaming.

With PProC-CS, the WirelessUSB NL transceiver can add wireless capability to a wide variety of CapSense applications.

The WirelessUSB NL is a fully-integrated CMOS RF transceiver, GFSK data modem, and packet framer, optimized for use in the 2.4-GHz ISM band. It contains transmit, receive, RF synthesizer, and digital modem functions, with few external components. The transmitter supports digital power control. The receiver uses extensive digital processing for excellent overall performance, even in the presence of interference and transmitter impairments.

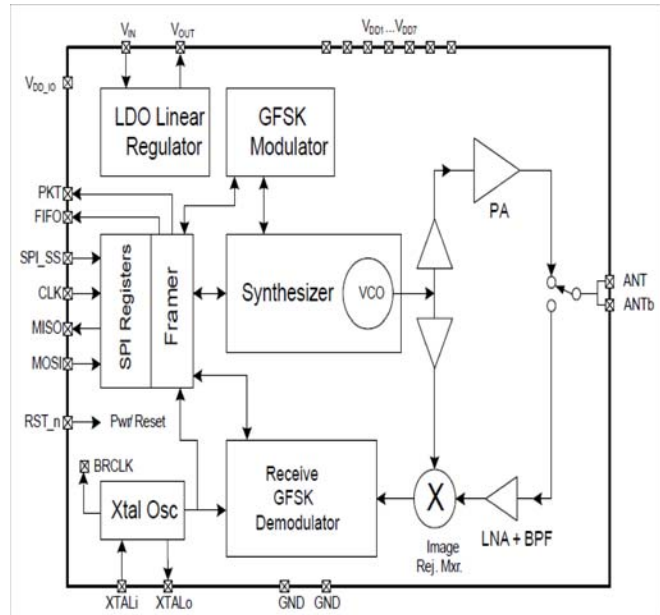
The product transmits GFSK data at approximately 0-dBm output power. Sigma-Delta PLL delivers high-quality DC-coupled transmit data path.

The low-IF receiver architecture produces good selectivity and image rejection, with typical sensitivity of -87 dBm or better on most channels. Sensitivity on channels that are integer multiples of the crystal reference oscillator frequency (12 MHz) may show approximately 5 dB degradation. Digital RSSI values are available to monitor channel quality.

On-chip transmit and receive FIFO registers are available to buffer the data transfer with MCU. Over-the-air data rate is always 1 Mbps even when connected to a slow, low-cost MCU. Built-in CRC, FEC, data whitening, and automatic retry/acknowledge are all available to simplify and optimize performance for individual applications.

For more details on the radio's implementation details and timing requirements, please go through the WirelessUSB NL datasheet in www.cypress.com.

Figure 2. WirelessUSB NL logic Block Diagram



Transmit Power Control

The following table lists recommended settings for register 9 for short-range applications, where reduced transmit RF power is a desirable trade off for lower current.

Table 1. Transmit Power Control

| Power Setting Description | Typical Transmit Power (dBm) | Register 9 |
|---------------------------|------------------------------|------------|
| PA0 - Highest power | +1 | 0x1820 |
| PA2 - High power | 0 | 0x1920 |
| PA4 - High power | -3 | 0x1A20 |
| PA8 - Low power | -7.5 | 0x1C20 |
| PA12 - Lower power | -11.2 | 0x1E20 |

Power-on and Register Initialization Sequence

For proper initialization at power up, V_{IN} must ramp up at the minimum overall ramp rate no slower than shown by T_{VIN} specification in the following figure. During this time, the RST_n line must track the V_{IN} voltage ramp-up profile to within approximately 0.2 V. Since most MCU GPIO pins automatically default to a high-Z condition at power up, it only requires a pull-up resistor. When power is stable and the MCU POR releases, and MCU begins to execute instructions, RST_n must then be pulsed

low as shown in [Figure 13 on page 32](#), followed by writing Reg[27] = 0x4200. During or after this SPI transaction, the State Machine status can be read to confirm FRAMER_ST= 1, indicating a proper initialization.

Additional System Resources

System resources provide additional capability, such as configurable I²C slave, SPI master/slave communication interface, three 16-bit programmable timers, and various system resets supported by the M8C.

These system resources 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).
- Low-voltage detection (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 reference provides an absolute reference for capacitive sensing.
- A register-controlled bypass mode allows the user to disable the LDO regulator.

Getting Started

The quickest way to understand the PSoC-CS silicon is to read this datasheet and then use the PSoC Designer Integrated Development Environment (IDE). This datasheet 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 [Technical Reference Manual](#) for the CapSense devices.

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

CapSense Design Guides

Design Guides are an excellent introduction to the wide variety of possible CapSense designs. They are located at www.cypress.com/go/CapSenseDesignGuides.

Refer [Getting Started with CapSense design guide](#) for information on CapSense design and CY8C20XX6A/H/AS CapSense[®] Design Guide for specific information on PSoC-CS controllers.

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.

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

The tool also supports easy development of multiple configurations and dynamic reconfiguration. Dynamic reconfiguration makes it possible to change configurations at run time. In essence, this lets 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 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 lets 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 lowering inventory costs. These configurable resources, called PSoC blocks, have the ability to implement a wide variety of user-selectable functions. The PSoC development process is:

1. Select [user modules](#).
2. Configure user modules.
3. Organize and connect.
4. Generate, verify, and debug.

Select User Modules

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

Configure User Modules

Each user module that you select establishes the basic register settings that implement the selected function. They also provide parameters and properties that allow you to tailor their precise configuration to your particular application. For example, a PWM User Module configures one or more digital PSoC blocks, one for each eight bits of resolution. Using these parameters, you can 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 of 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 that you may need to successfully implement your design.

Organize and Connect

Build signal chains at the chip level by interconnecting user modules to each other and the I/O pins. 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, 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 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 lets 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 (accessed 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. The interface lets you to define complex breakpoint events that include monitoring address and data bus values, memory locations, and external signals.

Pin Definitions

| Pin No | Pin name | Pin Description |
|---------------------------|---------------------------|---|
| 1 | P1[3]/SCLK ^[2] | Digital I/O, Analog I/O, SPI CLK |
| 2 | P1[1]/MOSI ^[1] | Digital I/O, Analog I/O, TC CLK, I2C SCL, SPI MOSI |
| 3 | GND | Ground connection |
| 4, 20, 25, 33, 34, 37, 40 | VDD | Core power supply voltage. Connect all VDD pins to VOUT pin. |
| 5 | DNU | Do not use |
| 6 | DNU | Do not use |
| 7 | FIFO | FIFO status indicator bit |
| 8 | DNU | Do not use |
| 9 | P1[0] ^[1] | Analog I/O, Digital I/O, TC DATA, I2C SDA |
| 10, 21, 24 | VIN | Unregulated input voltage to the on-chip low drop out (LDO) voltage regulator |
| 11 | P1[2] | Analog I/O, Digital I/O |
| 12 | P1[4] | Analog I/O, Digital I/O, EXT CLK |
| 13 | XRES | Active high external reset with internal pull-down |
| 14 | SPI_SS | Enable input for SPI, active low. Also used to bring device out of sleep state. |
| 15 | PKT | Transmit/receive packet status indicator bit |
| 16 | SPI_CLK | Clock input for SPI interface |
| 17 | SPI_MOSI | Data input for the SPI bus |
| 18 | SPI_MISO | Data output (tristate when not active) |
| 19 | RST_n | RST_n Low: Chip shutdown to conserve power. Register values lost RST_n High: Turn on chip, registers restored to default value |
| 22 | VOUT | 1.8 V output from on-chip LDO. Connect to all VDD pins, do not connect to external loads. |
| 23 | P0[4] | Analog I/O, Digital I/O, VREF |
| 26 | XTALO | Output of the crystal oscillator gain block |
| 27 | XTALI | Input to the crystal oscillator gain block |
| 28 | P0[7] | Analog I/O, Digital I/O, SPI CLK |
| 29 | P0[3] | Analog I/O, Digital I/O, Integrating input |
| 30 | P0[1] | Analog I/O, Digital I/O, Integrating input |
| 31 | P2[5] | Analog I/O, Digital I/O, XTAL Out |
| 32 | P2[3] | Analog I/O, Digital I/O, XTAL In |
| 35 | ANTb | Differential RF input/output. Each of these pins must be DC grounded, 20 kΩ or less |
| 36 | ANT | Differential RF input/output. Each of these pins must be DC grounded, 20 kΩ or less |
| 38 | P1[7]/SS_N | Digital I/O, Analog I/O, I2C SCL, SPI SS |
| 39 | P1[5]/MISO | Digital I/O, Analog I/O, I2C SDA, SPI MISO |

Notes

- On power-up, the SDA(P1[0]) drives a strong high for 256 sleep clock cycles and drives resistive low for the next 256 sleep clock cycles. The SCL(P1[1]) line drives resistive low for 512 sleep clock cycles and both the pins transition to high impedance state. On reset, after XRES de-asserts, the SDA and the SCL lines drive resistive low for 8 sleep clock cycles and transition to high impedance state. Hence, during power-up or reset event, P1[1] and P1[0] may disturb the I2C bus. Use alternate pins if you encounter issues.
- Alternate SPI clock.

Absolute Maximum Ratings

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

Table 2. Absolute Maximum Ratings

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|---------------------------------|-----------------------------------|---|--------------------|-----|-----------|-------|
| T _{STG} | Storage temperature | Higher storage temperatures reduce data retention time. Recommended Storage Temperature is +25 °C ± 25 °C. Extended duration storage temperatures above 85 °C degrades reliability. | TBD | TBD | TBD | °C |
| V _{IN} ^[3] | | – | 1.9 | – | 3.63 | V |
| V _{DD} | Supply voltage | – | –0.5 | – | 1.98 | V |
| V _{IO} | DC input voltage | – | –0.5 | – | VDD + 0.5 | V |
| V _{IOZ} ^[4] | DC voltage applied to tristate | – | –0.5 | – | VDD + 0.5 | V |
| I _{MIO} | Maximum current into any port pin | – | TBD | TBD | TBD | mA |
| ESD | Electrostatic discharge voltage | Human body model ESD i) RF pins (ANT, ANTb) ii) Analog pins (XTALi, XTALo) iii) Remaining pins | 500 500 2000 | – | – | V |
| LU | Latch-up current | In accordance with JEESD78 standard | – | – | 140 | mA |

Operating Temperature

Table 3. Operating Temperature

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|----------------|-----------------------------|---|-----|-----|-----|-------|
| T _A | Ambient temperature | – | 0 | – | 70 | °C |
| T _J | Operational die temperature | The temperature rise from ambient to junction is package specific. Refer the Thermal Impedances on page 34 . The user must limit the power consumption to comply with this requirement. | TBD | TBD | TBD | °C |

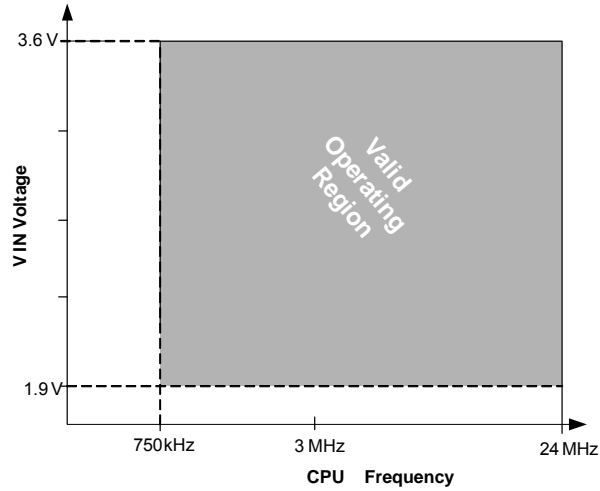
Notes

3. Program the device at 3.3 V only. Hence use MiniProg3 only as MiniProg1 does not support programming at 3.3 V.
4. Port1 pins are hot-swap capable with I/O configured in High-Z mode, and pin input voltage above V_{IN}.

Electrical Specifications – PSoC Core

This section presents the DC and AC electrical specifications of the CYRF89435 PSoC devices. For the latest electrical specifications, confirm that you have the most recent datasheet by visiting the web at <http://www.cypress.com/psoc>.

Figure 4. Voltage versus CPU Frequency



DC Chip-Level Specifications

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

Table 4. DC Chip-Level Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|-------------------------|---|--|-----|------|------|---------|
| $V_{IN}^{[5, 6, 7, 8]}$ | Supply voltage | Refer the table DC POR and LVD Specifications on page 18 | 1.9 | – | 3.6 | V |
| I_{DD24} | Supply current, IMO = 24 MHz | Conditions are $V_{IN} \leq 3.0$ V, $T_A = 25$ °C, CPU = 24 MHz. CapSense running at 12 MHz, no I/O sourcing current | – | 2.88 | 4.00 | mA |
| I_{DD12} | Supply current, IMO = 12 MHz | Conditions are $V_{IN} \leq 3.0$ V, $T_A = 25$ °C, CPU = 12 MHz. CapSense running at 12 MHz, no I/O sourcing current | – | 1.71 | 2.60 | mA |
| I_{DD6} | Supply current, IMO = 6 MHz | Conditions are $V_{IN} \leq 3.0$ V, $T_A = 25$ °C, CPU = 6 MHz. CapSense running at 6 MHz, no I/O sourcing current | – | 1.16 | 1.80 | mA |
| $I_{DDAVG10}$ | Average supply current per sensor | One sensor scanned at 10 ms rate | – | 250 | – | μ A |
| $I_{DDAVG100}$ | Average supply current per sensor | One sensor scanned at 100 ms rate | – | 25 | – | μ A |
| $I_{DDAVG500}$ | Average supply current per sensor | One sensor scanned at 500 ms rate | – | 7 | – | μ A |
| I_{SB0} | Deep sleep current | $V_{IN} \leq 3.0$ V, $T_A = 25$ °C, I/O regulator turned off | – | 0.10 | 1.05 | μ A |
| I_{SB1} | Standby current with POR, LVD and sleep timer | $V_{IN} \leq 3.0$ V, $T_A = 25$ °C, I/O regulator turned off | – | 1.07 | 1.50 | μ A |
| I_{SB12C} | Standby current with I ² C enabled | Conditions are $V_{IN} = 3.3$ V, $T_A = 25$ °C and CPU = 24 MHz | – | 1.64 | – | μ A |

Notes

- If powering down in standby sleep mode, to properly detect and recover from a V_{IN} brown out condition any of the following actions must be taken:
 Bring the device out of sleep before powering down.
 Assure that V_{IN} falls below 100 mV before powering back up.
 Set the No Buzz bit in the OSC_CR0 register to keep the voltage monitoring circuit powered during sleep.
 Increase the buzz rate to assure that the falling edge of V_{IN} is captured. The rate is configured through the PSSDC bits in the SLP_CFG register.
 For the referenced registers, refer to the *CY8C20X36 Technical Reference Manual*. In deep sleep mode, additional low power voltage monitoring circuitry allows V_{IN} brown out conditions to be detected for edge rates slower than 1V/ms.
- Always greater than 50 mV above V_{PPOR1} voltage for falling supply.
- Always greater than 50 mV above V_{PPOR2} voltage for falling supply.
- Always greater than 50 mV above V_{PPOR3} voltage for falling supply.

DC GPIO Specifications

The following tables list guaranteed maximum and minimum specifications for the voltage and temperature ranges: 2.4 V to 3.0 V and $0\text{ }^{\circ}\text{C} \leq T_A \leq 70\text{ }^{\circ}\text{C}$, or 1.9 V to 2.4 V and $0\text{ }^{\circ}\text{C} \leq T_A \leq 70\text{ }^{\circ}\text{C}$, respectively. Typical parameters apply to 3.3 V at 25 °C and are for design guidance only.

Table 5. 2.4 V to 3.0 V DC GPIO Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|-----------------------|---|--|------------------------|------|------|-------|
| R _{PU} | Pull-up resistor | – | 4 | 5.60 | 8 | kΩ |
| V _{OH1} | High output voltage Port 2 or 3 or 4 pins | I _{OH} < 10 μA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.20 | – | – | V |
| V _{OH2} | High output voltage Port 2 or 3 or 4 pins | I _{OH} = 0.2 mA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.40 | – | – | V |
| V _{OH3} | High output voltage Port 0 or 1 pins with LDO regulator Disabled for port 1 | I _{OH} < 10 μA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.20 | – | – | V |
| V _{OH4} | High output voltage Port 0 or 1 pins with LDO regulator Disabled for Port 1 | I _{OH} = 2 mA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.50 | – | – | V |
| V _{OH5A} | High output voltage Port 1 pins with LDO enabled for 1.8 V out | I _{OH} < 10 μA, V _{IN} > 2.4 V, maximum of 20 mA source current in all I/Os | 1.50 | 1.80 | 2.10 | V |
| V _{OH6A} | High output voltage Port 1 pins with LDO enabled for 1.8 V out | I _{OH} = 1 mA, V _{IN} > 2.4 V, maximum of 20 mA source current in all I/Os | 1.20 | – | – | V |
| V _{OL} | Low output voltage | I _{OL} = 10 mA, maximum of 30 mA sink current on even port pins (for example, P0[2] and P1[4]) and 30 mA sink current on odd port pins (for example, P0[3] and P1[5]) | – | – | 0.75 | V |
| V _{IL} | Input low voltage | – | – | – | 0.72 | V |
| V _{IH} | Input high voltage | – | 1.40 | – | – | V |
| V _H | Input hysteresis voltage | – | – | 80 | – | mV |
| I _{IL} | Input leakage (absolute value) | – | – | 1 | 1000 | nA |
| C _{PIN} | Capacitive load on pins | Package and pin dependent Temp = 25 °C | 0.50 | 1.70 | 7 | pF |
| V _{ILLVT2.5} | Input Low Voltage with low threshold enable set, Enable for Port1 | Bit3 of IO_CFG1 set to enable low threshold voltage of Port1 input | 0.7 | – | – | V |
| V _{IHLVT2.5} | Input High Voltage with low threshold enable set, Enable for Port1 | Bit3 of IO_CFG1 set to enable low threshold voltage of Port1 input | 1.2 | – | – | V |

Table 6. 1.9 V to 2.4 V DC GPIO Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|------------------|---|---|------------------------|------|------------------------|-------|
| R _{PU} | Pull-up resistor | – | 4 | 5.60 | 8 | kΩ |
| V _{OH1} | High output voltage Port 2 or 3 or 4 pins | I _{OH} = 10 μA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.20 | – | – | V |
| V _{OH2} | High output voltage Port 2 or 3 or 4 pins | I _{OH} = 0.5 mA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.50 | – | – | V |
| V _{OH3} | High output voltage Port 0 or 1 pins with LDO regulator Disabled for Port 1 | I _{OH} = 100 μA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.20 | – | – | V |
| V _{OH4} | High output voltage Port 0 or 1 Pins with LDO Regulator Disabled for Port 1 | I _{OH} = 2 mA, maximum of 10 mA source current in all I/Os | V _{IN} – 0.50 | – | – | V |
| V _{OL} | Low output voltage | I _{OL} = 5 mA, maximum of 20 mA sink current on even port pins (for example, P0[2] and P1[4]) and 30 mA sink current on odd port pins (for example, P0[3] and P1[5]) | – | – | 0.40 | V |
| V _{IL} | Input low voltage | – | – | – | 0.30 × V _{IN} | V |
| V _{IH} | Input high voltage | – | 0.65 × V _{IN} | – | – | V |
| V _H | Input hysteresis voltage | – | – | 80 | – | mV |
| I _{IL} | Input leakage (absolute value) | – | – | 1 | 1000 | nA |
| C _{PIN} | Capacitive load on pins | Package and pin dependent temp = 25 °C | 0.50 | 1.70 | 7 | pF |

Analog DC Mux Bus Specifications

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

Table 7. 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 GND | – | – | – | 800 | Ω |

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

DC Low Power Comparator Specifications

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

Table 8. DC Comparator Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|--------------------|--|--|-----|-----|-----|-------|
| V _{LPC} | Low power comparator (LPC) common mode | Maximum voltage limited to V _{IN} | 0.0 | – | 1.8 | V |
| I _{LPC} | LPC supply current | – | – | 10 | 40 | μA |
| V _{OSLPC} | LPC voltage offset | – | – | 3 | 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: $0\text{ }^{\circ}\text{C} \leq T_A \leq 70\text{ }^{\circ}\text{C}$, $1.9\text{ V} \leq V_{IN} \leq 3.6\text{ V}$.

Table 9. Comparator User Module Electrical Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|-------------------|--------------------------|---|-----|-----|-----|---------------|
| t_{COMP} | Comparator response time | 50 mV overdrive | – | 70 | 100 | ns |
| Offset | | Valid from 0.2 V to $V_{IN} - 0.2\text{ V}$ | – | 2.5 | 30 | mV |
| Current | | Average DC current, 50 mV overdrive | – | 20 | 80 | μA |
| PSRR | Supply voltage > 2 V | Power supply rejection ratio | – | 80 | – | dB |
| | Supply voltage < 2 V | Power supply rejection ratio | – | 40 | – | dB |
| Input range | | – | 0 | | 1.5 | V |

ADC Electrical Specifications
Table 10. ADC User Module Electrical Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|------------------------|------------------------------|--|------------------------|------------------------|------------------------|-------|
| Input | | | | | | |
| V _{IN} | Input voltage range | – | 0 | – | VREFADC | V |
| C _{IIN} | Input capacitance | – | – | – | 5 | pF |
| 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 |
| Reference | | | | | | |
| V _{REFADC} | ADC reference voltage | – | 1.14 | – | 1.26 | V |
| Conversion Rate | | | | | | |
| F _{CLK} | Data clock | Source is chip's internal main oscillator. See AC Chip-Level Specifications for accuracy | 2.25 | – | 6 | MHz |
| S8 | 8-bit sample rate | Data clock set to 6 MHz. Sample rate = 0.001 / (2 ^{Resolution} /Data Clock) | – | 23.43 | – | kSPS |
| S10 | 10-bit sample rate | Data clock set to 6 MHz. Sample rate = 0.001 / (2 ^{resolution} /data clock) | – | 5.85 | – | kSPS |
| DC Accuracy | | | | | | |
| RES | Resolution | Can be set to 8-, 9-, or 10-bit | 8 | – | 10 | bits |
| DNL | Differential nonlinearity | – | –1 | – | +2 | LSB |
| INL | Integral nonlinearity | – | –2 | – | +2 | LSB |
| E _{OFFSET} | Offset error | 8-bit resolution | 0 | 3.20 | 19.20 | LSB |
| | | 10-bit resolution | 0 | 12.80 | 76.80 | LSB |
| E _{GAIN} | Gain error | For any resolution | –5 | – | +5 | %FSR |
| Power | | | | | | |
| I _{ADC} | Operating current | – | – | 2.10 | 2.60 | mA |
| PSRR | Power supply rejection ratio | PSRR (VIN > 3.0 V) | – | 24 | – | dB |
| | | PSRR (VIN < 3.0 V) | – | 30 | – | dB |

DC POR and LVD Specifications

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

Table 11. DC POR and LVD Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|-------------------|----------------------------------|---|----------------------|------|------|-------|
| V _{POR1} | 2.36 V selected in PSoC Designer | V _{IN} must be greater than or equal to 1.9 V during startup, reset from the XRES pin, or reset from watchdog. | – | 2.36 | 2.41 | V |
| V _{POR2} | 2.60 V selected in PSoC Designer | | – | 2.60 | 2.66 | |
| V _{POR3} | 2.82 V selected in PSoC Designer | | – | 2.82 | 2.95 | |
| V _{LVD0} | 2.45 V selected in PSoC Designer | – | 2.40 | 2.45 | 2.51 | V |
| V _{LVD1} | 2.71 V selected in PSoC Designer | | 2.64 ^[9] | 2.71 | 2.78 | |
| V _{LVD2} | 2.92 V selected in PSoC Designer | | 2.85 ^[10] | 2.92 | 2.99 | |
| V _{LVD3} | 3.02 V selected in PSoC Designer | | 2.95 ^[11] | 3.02 | 3.09 | |
| V _{LVD4} | 3.13 V selected in PSoC Designer | | 3.06 | 3.13 | 3.20 | |
| V _{LVD5} | 1.90 V selected in PSoC Designer | | 1.84 | 1.90 | 2.32 | |

DC Programming Specifications

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

Table 12. DC Programming Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|-----------------------|---|--|-----------------|-----|-----------------|-------|
| V _{IN} | Supply voltage for flash write operations | – | 1.91 | – | 3.6 | V |
| I _{DDP} | Supply current during programming or verify | – | – | 5 | 25 | mA |
| V _{ILP} | Input low voltage during programming or verify | See the appropriate DC GPIO Specifications on page 14 | – | – | V _{IL} | V |
| V _{IHP} | Input high voltage during programming or verify | See the appropriate DC GPIO Specifications on page 14 | V _{IH} | – | – | V |
| I _{ILP} | Input current when Applying V _{ILP} to P1[0] or P1[1] during programming or verify | Driving internal pull-down resistor | – | – | 0.2 | mA |
| I _{IHP} | Input current when applying V _{IHP} to P1[0] or P1[1] during programming or verify | Driving internal pull-down resistor | – | – | 1.5 | mA |
| V _{OLP} | Output low voltage during programming or verify | | – | – | + 0.75 | V |
| V _{OHP} | Output high voltage during programming or verify | See appropriate DC GPIO Specifications on page 14 . For V _{IN} > 3 V use V _{OH4} in Table 3 on page 11 . | V _{OH} | – | V _{IN} | V |
| Flash _{ENPB} | Flash write endurance | Erase/write cycles per block | 50,000 | – | – | – |
| Flash _{DR} | Flash data retention | Following maximum Flash write cycles; ambient temperature of 55 °C | 20 | – | – | Years |

Notes

- 9. Always greater than 50 mV above V_{PPOR1} voltage for falling supply.
- 10. Always greater than 50 mV above V_{PPOR2} voltage for falling supply.
- 11. Always greater than 50 mV above V_{PPOR3} voltage for falling supply.

DC I²C Specifications

The following tables list guaranteed maximum and minimum specifications for the voltage and temperature ranges: 3, 2.4 V to 3.0 V and 0 °C ≤ T_A ≤ 70 °C, or 1.9 V to 2.4 V and 0 °C ≤ T_A ≤ 70 °C, respectively. Typical parameters apply to 3.3 V at 25 °C and are for design guidance only.

Table 13. DC I²C Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|--------------------|------------------|---------------------------------|------------------------|-----|------------------------|-------|
| V _{ILI2C} | Input low level | 3.1 V ≤ V _{IN} ≤ 3.6 V | – | – | 0.25 × V _{IN} | V |
| | | 2.5 V ≤ V _{IN} ≤ 3.0 V | – | – | 0.3 × V _{IN} | V |
| | | 1.9 V ≤ V _{IN} ≤ 2.4 V | – | – | 0.3 × V _{IN} | V |
| V _{IHI2C} | Input high level | 1.9 V ≤ V _{IN} ≤ 3.6 V | 0.65 × V _{IN} | – | – | V |

DC Reference Buffer Specifications

The following tables list guaranteed maximum and minimum specifications for the voltage and temperature ranges: 2.4 V to 3.0 V and 0 °C ≤ T_A ≤ 70 °C, or 1.9 V to 2.4 V and 0 °C ≤ T_A ≤ 70 °C, respectively. Typical parameters apply to 3.3 V at 25 °C and are for design guidance only.

Table 14. DC Reference Buffer Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|--------------------|-------------------------|----------------|-----|-----|------|-------|
| V _{Ref} | Reference buffer output | 1.9 V to 3.6 V | 1 | – | 1.05 | V |
| V _{RefHi} | Reference buffer output | 1.9 V to 3.6 V | 1.2 | – | 1.25 | V |

DC IDAC Specifications

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

Table 15. DC IDAC Specifications

| Symbol | Description | Min | Typ | Max | Units | Notes |
|--------------------|---------------------------|-------|-----|-------|-------|---|
| IDAC_DNL | Differential nonlinearity | –4.5 | – | +4.5 | LSB | |
| IDAC_INL | Integral nonlinearity | –5 | – | +5 | LSB | |
| IDAC_Gain (Source) | Range = 0.5x | 6.64 | – | 22.46 | μA | DAC setting = 128 dec. Not recommended for CapSense applications. |
| | Range = 1x | 14.5 | – | 47.8 | μA | |
| | Range = 2x | 42.7 | – | 92.3 | μA | |
| | Range = 4x | 91.1 | – | 170 | μA | DAC setting = 128 dec |
| | Range = 8x | 184.5 | – | 426.9 | μA | DAC setting = 128 dec |

AC Chip-Level Specifications

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

Table 16. AC Chip-Level Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|------------------------|---|---|------|-----|-------|-------|
| F _{IMO24} | IMO frequency at 24 MHz Setting | – | 22.8 | 24 | 25.2 | MHz |
| F _{IMO12} | IMO frequency at 12 MHz setting | – | 11.4 | 12 | 12.6 | MHz |
| F _{IMO6} | IMO frequency at 6 MHz setting | – | 5.7 | 6.0 | 6.3 | MHz |
| F _{CPU} | CPU frequency | – | 0.75 | – | 25.20 | MHz |
| F _{32K1} | ILO frequency | – | 19 | 32 | 50 | kHz |
| F _{32K_U} | ILO untrimmed frequency | – | 13 | 32 | 82 | kHz |
| DC _{IMO} | Duty cycle of IMO | – | 40 | 50 | 60 | % |
| DC _{ILO} | ILO duty cycle | – | 40 | 50 | 60 | % |
| SR _{POWER_UP} | Power supply slew rate | VIN slew rate during power-up | – | – | 250 | V/ms |
| t _{XRST} | External reset pulse width at power-up | After supply voltage is valid | 1 | – | – | ms |
| t _{XRST2} | External reset pulse width after power-up | Applies after part has booted | 10 | – | – | μs |
| t _{OS} | Startup time of ECO | – | – | 1 | – | s |
| t _{JIT_IMO} | N = 32 | 6 MHz IMO cycle-to-cycle jitter (RMS) | – | 0.7 | 6.7 | ns |
| | | 6 MHz IMO long term N (N = 32) cycle-to-cycle jitter (RMS) | – | 4.3 | 29.3 | ns |
| | | 6 MHz IMO period jitter (RMS) | – | 0.7 | 3.3 | ns |
| | | 12 MHz IMO cycle-to-cycle jitter (RMS) | – | 0.5 | 5.2 | ns |
| | | 12 MHz IMO long term N (N = 32) cycle-to-cycle jitter (RMS) | – | 2.3 | 5.6 | ns |
| | | 12 MHz IMO period jitter (RMS) | – | 0.4 | 2.6 | ns |
| | | 24 MHz IMO cycle-to-cycle jitter (RMS) | – | 1.0 | 8.7 | ns |
| | | 24 MHz IMO long term N (N = 32) cycle-to-cycle jitter (RMS) | – | 1.4 | 6.0 | ns |
| | | 24 MHz IMO period jitter (RMS) | – | 0.6 | 4.0 | ns |

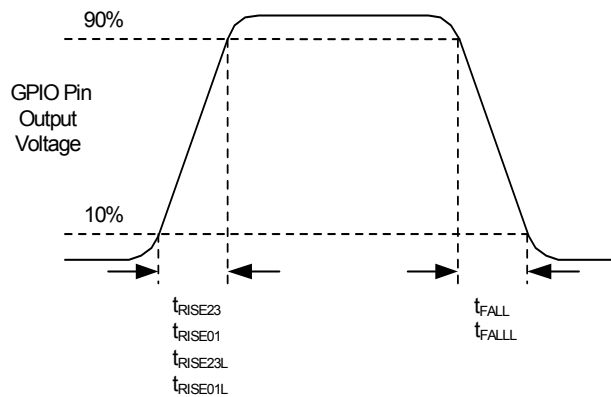
AC GPIO Specifications

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

Table 17. AC GPIO Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|---------------|---|--|-----|-----|---|------------|
| F_{GPIO} | GPIO operating frequency | Normal strong mode Port 0, 1 | 0 | – | 6 MHz for 1.9 V < VIN < 2.40 V 12 MHz for 2.40 V < VIN < 3.6 V | MHz MHz |
| t_{RISE23} | Rise time, strong mode, Clload = 50 pF Port 2 or 3 or 4 pins | VIN = 3.0 to 3.6 V, 10% to 90% | 15 | – | 80 | ns |
| $t_{RISE23L}$ | Rise time, strong mode low supply, Clload = 50 pF, Port 2 or 3 or 4 pins | VIN = 1.9 to 3.0 V, 10% to 90% | 15 | – | 80 | ns |
| t_{RISE01} | Rise time, strong mode, Clload = 50 pF, Ports 0 or 1 | VIN = 3.0 to 3.6 V, 10% to 90%, LDO enabled or disabled | 10 | – | 50 | ns |
| $t_{RISE01L}$ | Rise time, strong mode low supply, Clload = 50 pF, Ports 0 or 1 | VIN = 1.9 to 3.0 V, 10% to 90%, LDO enabled or disabled | 10 | – | 80 | ns |
| t_{FALL} | Fall time, strong mode, Clload = 50 pF, all ports | VIN = 3.0 to 3.6 V, 10% to 90% | 10 | – | 50 | ns |
| t_{FALLL} | Fall time, strong mode low supply, Clload = 50 pF, all ports | VIN = 1.9 to 3.0 V, 10% to 90% | 10 | – | 70 | ns |

Figure 5. GPIO Timing Diagram



AC Comparator Specifications

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

Table 18. 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 External Clock Specifications

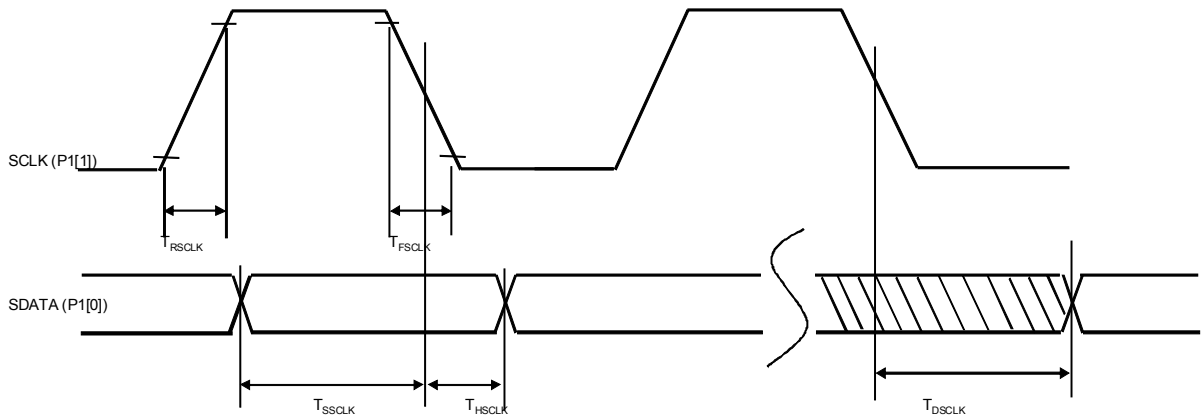
The following table lists guaranteed maximum and minimum specifications for the entire voltage and temperature ranges.

Table 19. AC External Clock Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|--------------|---|------------|-------|-----|-------|---------|
| F_{OSCEXT} | Frequency (external oscillator frequency) | – | 0.75 | – | 25.20 | MHz |
| | High period | – | 20.60 | – | 5300 | ns |
| | Low period | – | 20.60 | – | – | ns |
| | Power-up IMO to switch | – | 150 | – | – | μ s |

AC Programming Specifications

Figure 6. AC Waveform



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

Table 20. 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 setup time to falling edge of SCLK | – | 40 | – | – | ns |
| t _{HSCLK} | Data hold time from falling edge of SCLK | – | 40 | – | – | ns |
| F _{SCLK} | Frequency of SCLK | – | 0 | – | 8 | MHz |
| t _{ERASEB} | Flash erase time (block) | – | – | – | 18 | ms |
| t _{WRITE} | Flash block write time | – | – | – | 25 | ms |
| t _{DSCLK3} | Data out delay from falling edge of SCLK | 3.0 ≤ V _{DD} ≤ 3.6 | – | – | 85 | ns |
| t _{DSCLK2} | Data out delay from falling edge of SCLK | 1.9 ≤ V _{DD} ≤ 3.0 | – | – | 130 | ns |
| t _{XRST3} | External reset pulse width after power-up | Required to enter programming mode when coming out of sleep | 300 | – | – | μs |
| t _{XRES} | XRES pulse length | – | 300 | – | – | μs |
| t _{VDDWAIT} | V _{DD} stable to wait-and-poll hold off | – | 0.1 | – | 1 | ms |
| t _{VDDXRES} | V _{DD} stable to XRES assertion delay | – | 14.27 | – | – | ms |
| t _{POLL} | SDATA high pulse time | – | 0.01 | – | 200 | ms |
| t _{ACQ} | “Key window” time after a V _{DD} ramp acquire event, based on 256 ILO clocks. | – | 3.20 | – | 19.60 | ms |
| t _{XRESINI} | “Key window” time after an XRES event, based on 8 ILO clocks | – | 98 | – | 615 | μs |

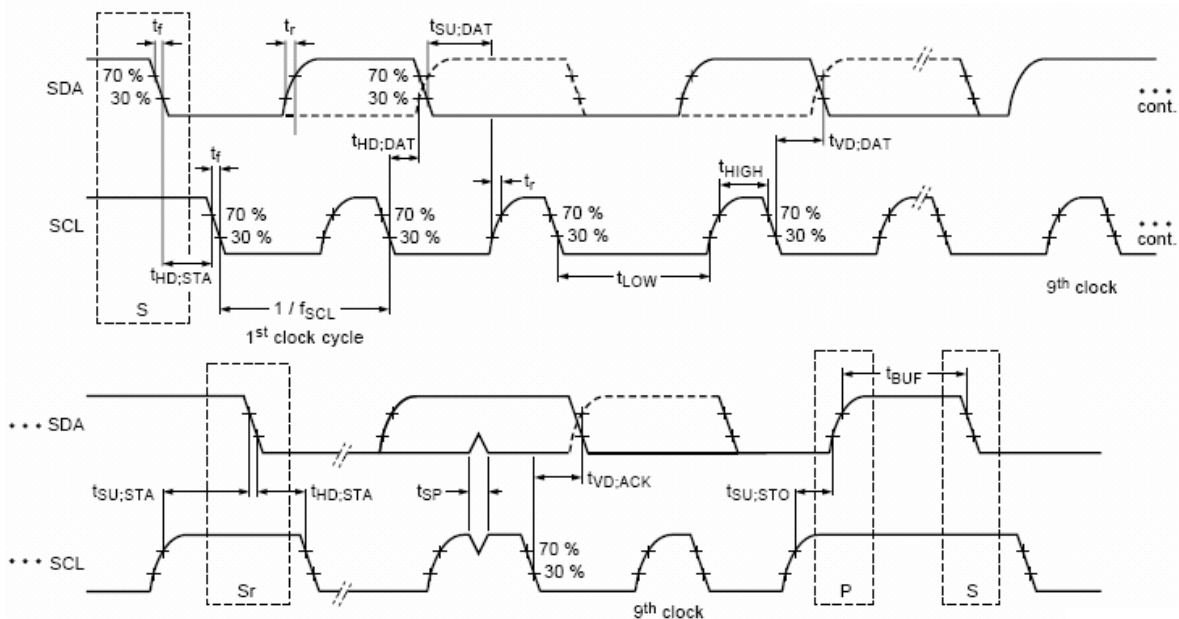
AC I²C Specifications

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

Table 21. AC Characteristics of the I²C SDA and SCL Pins

| Symbol | Description | Standard Mode | | Fast Mode | | Units |
|---------------------|---|---------------|------|---------------------|------|-------|
| | | Min | Max | Min | Max | |
| f _{SCL} | SCL clock frequency | 0 | 100 | 0 | 400 | kHz |
| t _{HD;STA} | Hold time (repeated) START condition. After this period, the first clock pulse is generated | 4.0 | – | 0.6 | – | µs |
| t _{LOW} | LOW period of the SCL clock | 4.7 | – | 1.3 | – | µs |
| t _{HIGH} | HIGH Period of the SCL clock | 4.0 | – | 0.6 | – | µs |
| t _{SU;STA} | Setup time for a repeated START condition | 4.7 | – | 0.6 | – | µs |
| t _{HD;DAT} | Data hold time | 0 | 3.45 | 0 | 0.90 | µs |
| t _{SU;DAT} | Data setup time | 250 | – | 100 ^[12] | – | ns |
| t _{SU;STO} | Setup time for STOP condition | 4.0 | – | 0.6 | – | µs |
| t _{BUF} | Bus free time between a STOP and START condition | 4.7 | – | 1.3 | – | µs |
| t _{SP} | Pulse width of spikes are suppressed by the input filter | – | – | 0 | 50 | ns |

Figure 7. Definition for Timing for Fast/Standard Mode on the I²C Bus



Note

12. A Fast-Mode I²C-bus device can be used in a standard mode I²C-bus system, but the requirement t_{SU;DAT} ≥ 250 ns must then be met. This automatically 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.

SPI Master AC Specifications

Table 22. SPI Master AC Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|-----------------|-------------------------|---|-----------|--------|--------|------------|
| F_{SCLK} | SCLK clock frequency | $V_{IN} \geq 2.4\text{ V}$ $V_{IN} < 2.4\text{ V}$ | – – | – – | 6 3 | MHz MHz |
| DC | SCLK duty cycle | – | – | 50 | – | % |
| t_{SETUP} | MISO to SCLK setup time | $V_{IN} \geq 2.4\text{ V}$ $V_{IN} < 2.4\text{ V}$ | 60 100 | – – | – – | ns ns |
| t_{HOLD} | SCLK to MISO hold time | – | 40 | – | – | ns |
| t_{OUT_VAL} | SCLK to MOSI valid time | – | – | – | 40 | ns |
| t_{OUT_HIGH} | MOSI high time | – | 40 | – | – | ns |

Figure 8. SPI Master Mode 0 and 2

SPI Master, modes 0 and 2

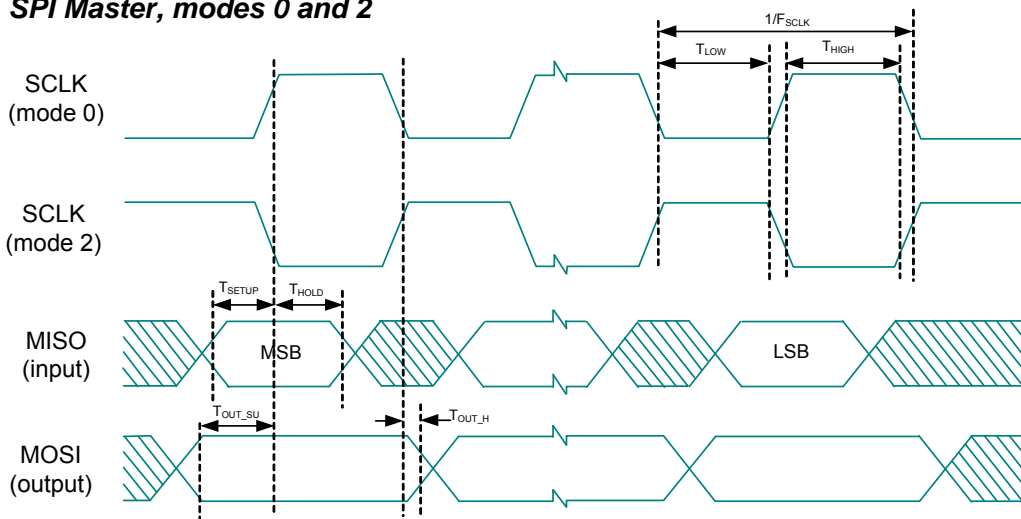
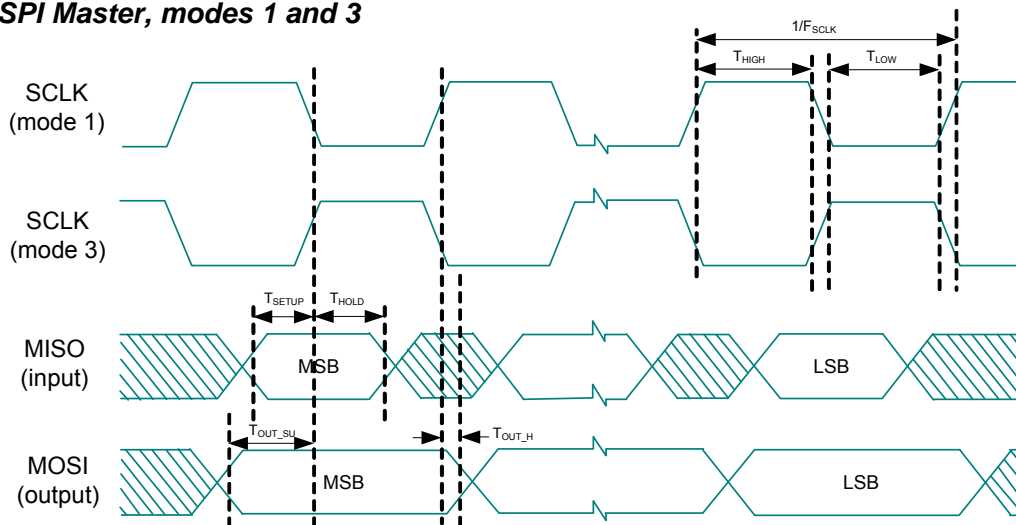


Figure 9. SPI Master Mode 1 and 3

SPI Master, modes 1 and 3



SPI Slave AC Specifications

Table 23. SPI Slave AC Specifications

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|------------------|--------------------------------|------------|----------|-----|-----|-------|
| F_{SCLK} | SCLK clock frequency | – | – | – | 4 | MHz |
| t_{LOW} | SCLK low time | – | 42 | – | – | ns |
| t_{HIGH} | SCLK high time | – | 42 | – | – | ns |
| t_{SETUP} | MOSI to SCLK setup time | – | 30 | – | – | ns |
| t_{HOLD} | SCLK to MOSI hold time | – | 50 | – | – | ns |
| t_{SS_MISO} | SS high to MISO valid | – | – | – | 153 | ns |
| t_{SCLK_MISO} | SCLK to MISO valid | – | – | – | 125 | ns |
| t_{SS_HIGH} | SS high time | – | 50 | – | – | ns |
| t_{SS_CLK} | Time from SS low to first SCLK | – | $2/SCLK$ | – | – | ns |
| t_{CLK_SS} | Time from last SCLK to SS high | – | $2/SCLK$ | – | – | ns |

Figure 10. SPI Slave Mode 0 and 2

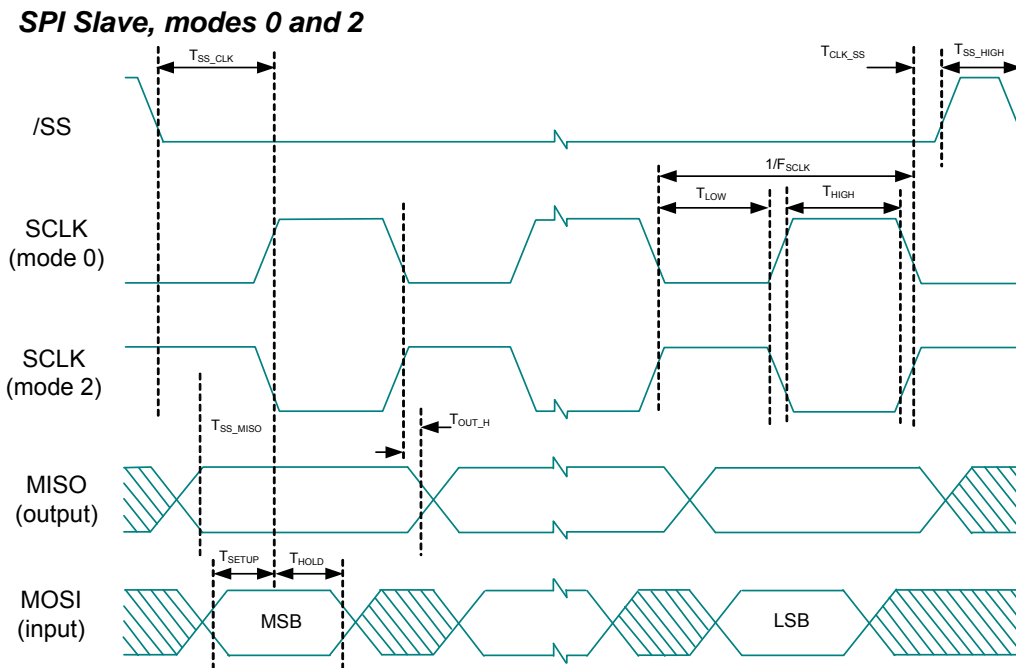
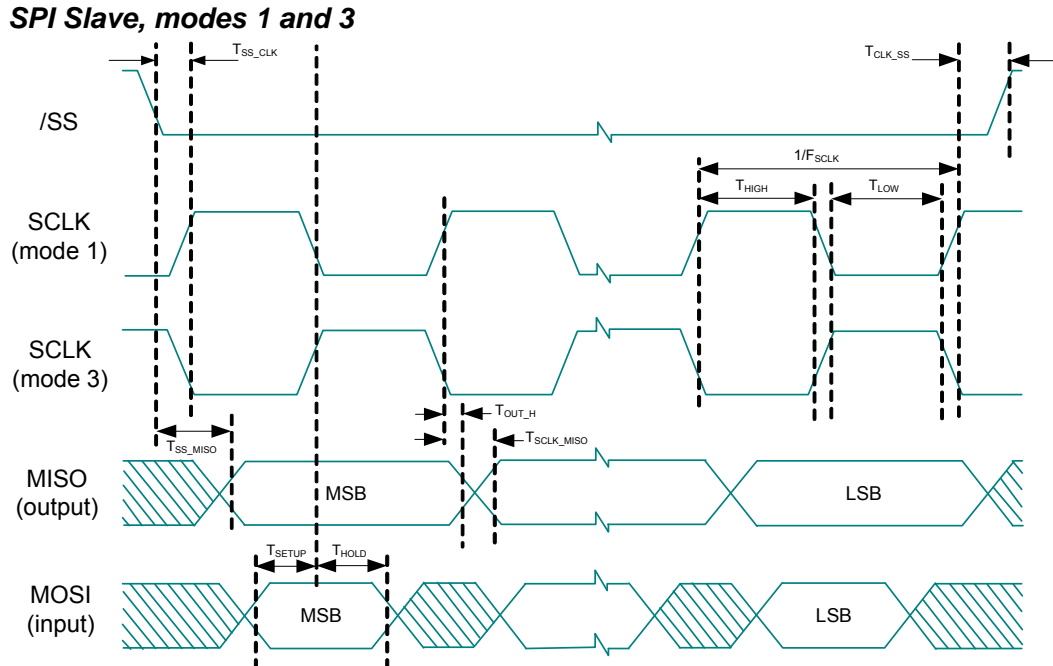


Figure 11. SPI Slave Mode 1 and 3



Electrical Specifications – RF Section

| Symbol | Description | Min | Typ | Max | Units | Test Condition and Notes |
|---------------------------------|---|---------------------|------|---------------------|-------|--|
| | Supply voltage | | | | | |
| V _{IN} | DC power supply voltage range | 1.9 | – | 3.6 | VDC | Input to V _{IN} pins |
| | Current consumption | | | | | |
| I _{DD_TX2} | Current consumption – Tx | – | 18.5 | – | mA | Transmit power PA2. BRCLK off. |
| I _{DD_TX12} | | – | 13.7 | – | mA | Transmit power PA12. BRCLK off |
| I _{DD_RX} | Current consumption – Rx | – | 18 | – | mA | BRCLK off |
| I _{DD_IDLE1} | Current consumption – idle | – | 1.1 | – | mA | Configured for BRCLK output off |
| I _{DD_SLPx} | Current consumption – sleep | – | 1 | – | μA | Temperature = +25 °C. Using firmware sleep patch. Register 27 = 0x1200, for V _{IN} ≥ 3.00 VDC only |
| I _{DD_SLP_r} | | – | 8 | – | μA | Temperature = +25 °C; using firmware sleep patch Register 27 = 0x4200. |
| I _{DD_SLP_h} | | – | 38 | – | μA | Temperature = +70 °C 'C' grade part; using firmware sleep patch Register 27 = 0x4200 |
| V _{IH} | Logic input high | 0.8 V _{IN} | – | 1.2 V _{IN} | V | |
| V _{IL} | Logic input low | 0 | – | 0.8 | V | |
| I _{LEAK_IN} | Input leakage current | – | – | 10 | μA | |
| | | | | | | |
| V _{OH} | Logic output high | 0.8 V _{IN} | – | – | V | I _{OH} = 100 μA source |
| V _{OL} | Logic output low | – | – | 0.4 | V | I _{OL} = 100 μA sink |
| I _{LEAK_OUT} | Output leakage current | – | – | 10 | μA | MISO in tristate |
| T _{RISE_OUT} | Rise/fall time (SPI MISO) | – | 8 | 25 | ns | 7 pF cap. load |
| T _{RISE_IN} | Rise/fall time (SPI MOSI) | – | – | 25 | ns | |
| T _{r_spi} | CLK rise, fall time (SPI) | – | – | 25 | ns | Requirement for error-free register reading, writing. |
| | | | | | | |
| F _{OP} | Operating frequency range | 2400 | – | 2482 | MHz | Usage on-the-air is subject to local regulatory agency restrictions regarding operating frequency. |
| V _{SWR_I} | Antenna port mismatch (Z ₀ = 50 Ω) | – | <2:1 | – | VSWR | Receive mode. Measured using LC matching circuit |
| V _{SWR_O} | | – | <2:1 | – | VSWR | Transmit mode. Measured using LC matching circuit |
| Receive section | | | | | | Measured using LC matching circuit for BER ≤ 0.1% |

Electrical Specifications – RF Section *(continued)*

| Symbol | Description | Min | Typ | Max | Units | Test Condition and Notes |
|------------------------------------|---|-----|-------|-----|-------|---|
| RxS _{base} | Receiver sensitivity (FEC off) | – | –87 | – | dBm | Room temperature only 0-ppm crystal frequency error. |
| RxS _{temp} | | – | –84 | – | dBm | Over temperature; 0-ppm crystal frequency error. |
| RxS _{ppm} | | – | –84 | – | dBm | Room temperature only 80-ppm total frequency error (± 40-ppm crystal frequency error, each end of RF link) |
| RxS _{temp+ppm} | | – | –80 | – | dBm | Over temperature; 80-ppm total frequency error (± 40-ppm crystal frequency error, each end of RF link) |
| R _{xmax-sig} | Maximum usable signal | –20 | 0 | – | dBm | Room temperature only |
| T _s | Data (Symbol) rate | – | 1 | – | µs | |
| Minimum Carrier/Interference ratio | | | | | | For BER ≤ 0.1%. Room temperature only. |
| CI _{_cochannel} | Co-channel interference | – | +9 | – | dB | –60-dBm desired signal |
| CI _{_1} | Adjacent channel interference, 1-MHz offset | – | +6 | – | dB | –60-dBm desired signal |
| CI _{_2} | Adjacent channel interference, 2-MHz offset | – | –12 | – | dB | –60-dBm desired signal |
| CI _{_3} | Adjacent channel interference, 3-MHz offset | – | –24 | – | dB | –67-dBm desired signal |
| OBB | Out-of-band blocking | – | ≥ –27 | – | dBm | 30 MHz to 12.75 GHz Measured with ACX BF2520 ceramic filter on ant. pin. –67-dBm desired signal, BER ≤ 0.1%. Room temperature only. |
| Transmit section | | | | | | Measured using a LC matching circuit |
| P _{AVH} | RF output power | – | +1 | – | dBm | PA0 (PA_GN = 0, Reg9 = 0x1820). Room temperature only |
| P _{AVL} | | – | –11.2 | – | dBm | PA12 (PA_GN = 12, Reg9 = 0x1E20). Room temperature only. |
| TxP _{fx2} | Second harmonic | – | –45 | – | dBm | Measured using a LC matching circuit. Room temperature only. |
| TxP _{fx3} | Third and higher harmonics | – | ≤ –45 | – | dBm | Measured using a LC matching circuit. Room temperature only. |
| Modulation characteristics | | | | | | |
| Df _{1avg} | | – | 263 | – | kHz | Modulation pattern: 11110000... |
| Df _{2avg} | | – | 255 | – | kHz | Modulation pattern: 10101010... |
| In-band spurious emission | | | | | | |
| IBS _{_2} | 2-MHz offset | – | – | –20 | dBm | |
| IBS _{_3} | 3-MHz offset | – | – | –30 | dBm | |
| IBS _{_4} | ≥ 4-MHz offset | – | ≤ –30 | – | dBm | |

Electrical Specifications – RF Section *(continued)*

| Symbol | Description | Min | Typ | Max | Units | Test Condition and Notes |
|-------------------------------|------------------------------------|-----|------|-----|---------------|--|
| RF VCO and PLL section | | | | | | |
| F_{step} | Channel (Step) size | | 1 | – | MHz | |
| L_{100k} | SSB phase noise | | –75 | – | dBc/Hz | 100-kHz offset |
| L_{1M} | | | –105 | – | dBc/Hz | 1-MHz offset |
| dF_{X0} | Crystal oscillator frequency error | –40 | – | +40 | ppm | Relative to 12-MHz crystal reference frequency |
| T_{HOP} | RF PLL settling time | – | 100 | 150 | μs | Settle to within 30 kHz of final value. AutoCAL off. |
| $T_{\text{HOP_AC}}$ | | – | 250 | 350 | μs | Settle to within 30 kHz of final value. AutoCAL on. |
| LDO voltage regulator section | | | | | | |
| V_{DO} | Dropout voltage | – | 0.17 | 0.3 | V | Measured during receive state |

Table 24. Initialization Timing Requirements

| Timing Parameter | Min | Max | Unit | Notes |
|-------------------|-----|----------|------|--|
| T _{RSU} | – | 30 / 150 | ms | 30 ms Reset setup time necessary to ensure complete Reset for V _{IN} = 6.5mV/s, 150 ms Reset setup time necessary to ensure complete Reset for V _{IN} = 2mV/s |
| T _{RPW} | 1 | 10 | µs | Reset pulse width necessary to ensure complete reset |
| T _{CMIN} | 3 | – | ms | Minimum recommended crystal oscillator and APLL settling time |
| T _{VIN} | – | 6.5 / 2 | mV/s | Maximum ramp time for V _{IN} , measured from 0 to 100% of final voltage. For example, if V _{IN} = 3.3 V, the max ramp time is 6.5 × 3.3 = 21.45 ms. If V _{IN} = 1.9 V, the max ramp time = 6.5 × 1.9 = 12.35 ms. Reset setup time necessary to ensure complete Reset for V _{IN} = 6.5 mV/s Reset setup time necessary to ensure complete Reset for V _{IN} = 6.5 mV/s Reset setup time necessary to ensure complete Reset for V _{IN} =6.5 mV/s |

Figure 12. Initialization Flowchart

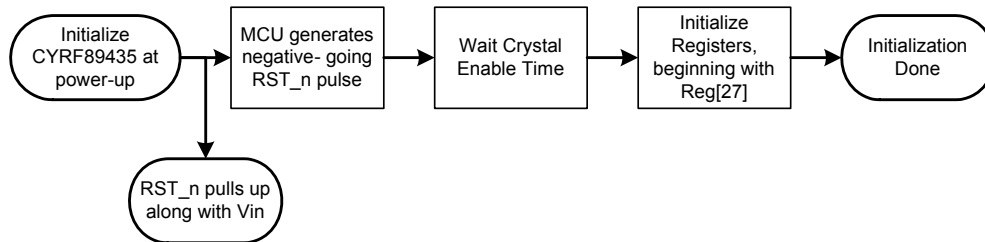
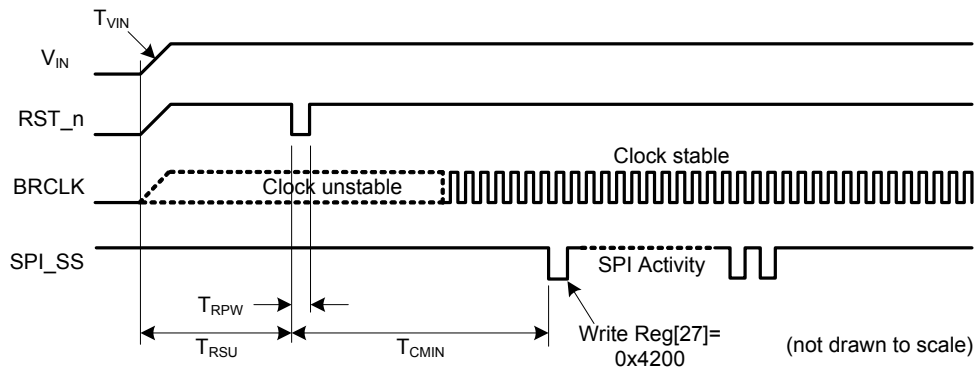


Table 25. SPI Timing Requirements

| Timing Parameter | Min | Max | Unit | Notes |
|--------------------|-----|-----|------|---|
| T _{SSS} | 20 | – | ns | Setup time from assertion of SPI_SS to CLK edge |
| T _{SSH} | 200 | – | ns | Hold time required deassertion of SPI_SS |
| T _{SCKH} | 20 | – | ns | CLK minimum high time |
| T _{SCKL} | 20 | – | ns | CLK minimum low time |
| T _{SCK} | 83 | – | ns | Maximum CLK clock is 12 MHz |
| T _{SSU} | 10 | – | ns | MOSI setup time |
| T _{SHD} | 10 | – | ns | MOSI hold time |
| T _{SS_SU} | 10 | – | ns | Before SPI_SS enable, CLK hold low time requirement |
| T _{SS_HD} | 200 | – | ns | Minimum SPI inactive time |
| T _{SDO} | – | 35 | ns | MISO setup time, ready to read |
| T _{SDO1} | – | 5 | ns | If MISO is configured as tristate, MISO assertion time |
| T _{SDO2} | – | 250 | ns | If MISO is configured as tristate, MISO deassertion time |
| T1 Min_R50 | 350 | – | ns | When reading register 50 (FIFO) |
| T1 Min | 83 | – | ns | When writing Register 50 (FIFO), or reading/writing any registers other than register 50. |

Figure 13. Power-on and Register Programming Sequence



- After RST_n transitions from 0 to 1, BRCLK begins running at 12-MHz clock.
- After register initialization, CYRF89435 is ready to transmit or receive.

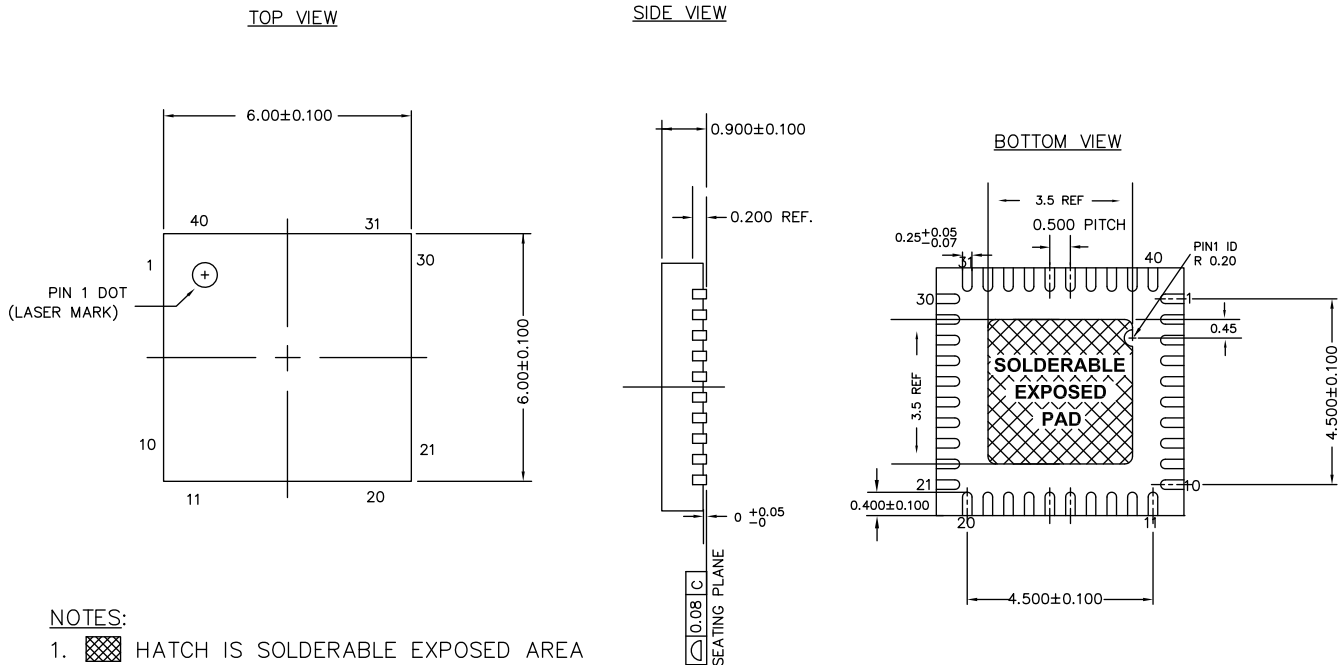
Packaging Information

This section illustrates the packaging specifications for the CY7C89435 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 14. 40-pin QFN (6 × 6 × 1.0 mm) LT40B 3.5 × 3.5 mm E-Pad (Sawn) Package Outline, 001-13190



NOTES:

1.  HATCH IS SOLDERABLE EXPOSED AREA
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.086g
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-13190 *H

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.

Thermal Impedances

Table 26. Thermal Impedances per Package

| Package | Typical θ_{JA} ^[13] | Typical θ_{JC} |
|----------------------------|---------------------------------------|-----------------------|
| 40-pin QFN ^[14] | 27°C/W | 34°C/W |

Capacitance on Crystal Pins

Table 27. Typical Package Capacitance on Crystal Pins

| Package | Package Capacitance |
|------------|---------------------|
| 40-pin QFN | TBD |

Solder Reflow Specifications

Table 28 shows the solder reflow temperature limits that must not be exceeded.

Table 28. Solder Reflow Specifications

| Package | Maximum Peak Temperature (T_C) | Maximum Time above $T_C - 5^\circ\text{C}$ |
|------------|------------------------------------|--|
| 40-pin QFN | TBD | TBD |

Notes

13. $T_J = T_A + \text{Power} \times \theta_{JA}$.

14. To achieve the thermal impedance specified for the QFN package, the center thermal pad must be soldered to the PCB ground plane.

Development Tool Selection

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 over half a decade. PSoC Designer is available free of charge at <http://www.cypress.com>.

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 are sold at the Cypress Online Store.

CY3215-DK Basic Development Kit

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

- PSoC Designer Software CD
- ICE-Cube In-Circuit Emulator
- ICE Flex-Pod for CY8C29X66A Family
- Cat-5 Adapter
- Mini-Eval Programming Board
- 110 ~ 240 V Power Supply, Euro-Plug Adapter
- iMAGEcraft C Compiler (Registration Required)
- ISSP Cable
- 2 CY8C29466A-24PXI 28-pin PDIP Chip Samples

Evaluation Tools

All evaluation tools are sold at the Cypress Online Store.

CY8CKIT-006 PSoC® 3 LCD Segment Drive Evaluation Kit

Cypress's PSoC programmable system-on-chip architecture gives you the freedom to not only imagine revolutionary new products, but the capability to also get those products to market faster than anyone else. The ability to drive a 5 V display on 0.5 V of input and the ability to drive multiple displays on one PSoC device can translate to the ultimate in design freedom, lower BOM costs and new product differentiators with this easy to use evaluation kit. The kit contains:

- PSoC 3 LCD Segment Drive Evaluation Board
- 9 V Battery
- 12 V Wall Power Supply
- MiniProg3 Programmer / Debugger
- USB Cable (to connect MiniProg3 to the PC)
- Kit Stand
- Quick Start Guide
- Kit CD, which includes: PSoC Creator, PSoC Programmer, Projects and Documentation

Device Programmers

Firmware needs to be downloaded to PSoC CS device only at 3.3 V using MiniProg3 Programmer. This Programmer kit can be purchased from Cypress Store using part# 'CY8CKIT-002 - MiniProg3'. It is a small, compact programmer which connects PC via a USB 2.0 cable (provided along with CY8cKIT-002).

Note: MiniProg1 Programmer should not be used as it does not support programming at 3.3 V.

Accessories (Emulation and Programming)

Table 29. Emulation and Programming Accessories

| Part Number | Pin Package | Flex-Pod Kit | Foot Kit | Adapter |
|-------------|-------------|--------------|----------|---------|
| TBD | TBD | TBD | TBD | TBD |

Third Party Tools

Several tools have been specially designed by the following third-party vendors to accompany PSoC devices during development and production. Specific details for each of these tools can be found at <http://www.cypress.com> under Documentation > Evaluation Boards.

Ordering Information

The following table lists the CY7C89435 PSoC devices' key package features and ordering codes.

Table 30. PSoC Device Key Features and Ordering Information

| Package | Ordering Code | Flash (Bytes) | SRAM (Bytes) | CapSense Blocks | Digital I/O Pins | Analog Inputs | XRES Pin | ADC |
|-----------------------------|------------------|---------------|--------------|-----------------|------------------|---------------|----------|-----|
| 40-pin (6 × 6 × 1.0 mm) QFN | CYRF89435-40LTXC | 32 K | 2 K | 1 | 13 | 13 | Yes | Yes |

Ordering Code Definitions

..... TBD

Acronyms

Table 31. Acronyms Used in this Document

| Acronym | Description |
|-------------------|---|
| AC | alternating current |
| ADC | analog-to-digital converter |
| API | application programming interface |
| CMOS | complementary metal oxide semiconductor |
| CPU | central processing unit |
| DAC | digital-to-analog converter |
| DC | direct current |
| EOP | end of packet |
| FSR | full scale range |
| GPIO | general purpose input/output |
| GUI | graphical user interface |
| I ² C | inter-integrated circuit |
| ICE | in-circuit emulator |
| IDAC | digital analog converter current |
| ILO | internal low speed oscillator |
| IMO | internal main oscillator |
| I/O | input/output |
| ISSP | in-system serial programming |
| LCD | liquid crystal display |
| LDO | low dropout (regulator) |
| LSB | least-significant bit |
| LVD | low voltage detect |
| MCU | micro-controller unit |
| MIPS | mega instructions per second |
| MISO | master in slave out |
| MOSI | master out slave in |
| MSB | most-significant bit |
| OCD | on-chip debugger |
| POR | power on reset |
| PPOR | precision power on reset |
| PSRR | power supply rejection ratio |
| PWRSYS | power system |
| PSoC [®] | Programmable System-on-Chip |
| SLIMO | slow internal main oscillator |
| SRAM | static random access memory |
| SNR | signal to noise ratio |
| QFN | quad flat no-lead |
| SCL | serial I2C clock |
| SDA | serial I2C data |
| SDATA | serial ISSP data |
| SPI | serial peripheral interface |
| SS | slave select |
| SSOP | shrink small outline package |
| TC | test controller |
| USB | universal serial bus |
| USB D+ | USB Data+ |
| USB D- | USB Data- |
| WLCSP | wafer level chip scale package |
| XTAL | crystal |

Reference Documents

- *Technical reference manual for CY8C20xx6 devices*
- *In-system Serial Programming (ISSP) protocol for 20xx6 (AN2026C)*
- *Host Sourced Serial Programming for 20xx6 devices (AN59389)*

Document Conventions

Units of Measure

Table 32. Units of Measure

| Symbol | Unit of Measure |
|--------|-------------------------------|
| °C | degree Celsius |
| dB | decibels |
| fF | femtofarad |
| g | gram |
| Hz | hertz |
| KB | 1024 bytes |
| Kbit | 1024 bits |
| KHz | kilohertz |
| Ksps | kilo samples per second |
| kΩ | kilohm |
| MHz | megahertz |
| MΩ | megaohm |
| μA | microampere |
| μF | microfarad |
| μH | microhenry |
| μs | microsecond |
| μW | microwatt |
| mA | milliampere |
| ms | millisecond |
| mV | millivolt |
| nA | nanoampere |
| nF | nanofarad |
| ns | nanosecond |
| nV | nanovolt |
| W | ohm |
| pA | picoampere |
| pF | picofarad |
| pp | peak-to-peak |
| ppm | parts per million |
| ps | picosecond |
| sps | samples per second |
| s | sigma: one standard deviation |
| V | volt |
| W | watt |

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.

Glossary

| | |
|-------------------------------------|---|
| Crosspoint connection | Connection between any GPIO combination via analog multiplexer bus. |
| Differential non-linearity | Ideally, any two adjacent digital codes correspond to output analog voltages that are exactly one LSB apart. Differential non-linearity is a measure of the worst case deviation from the ideal 1 LSB step. |
| Hold time | Hold time is the time following a clock event during which the data input to a latch or flip-flop must remain stable in order to guarantee that the latched data is correct. |
| I ² C | It is a serial multi-master bus used to connect low speed peripherals to MCU. |
| Integral nonlinearity | It is a term describing the maximum deviation between the ideal output of a DAC/ADC and the actual output level. |
| Latch-up current | Current at which the latch-up test is conducted according to JESD78 standard (at 125 degree Celsius) |
| Power supply rejection ratio (PSRR) | The PSRR is defined as the ratio of the change in supply voltage to the corresponding change in output voltage of the device. |
| Scan | The conversion of all sensor capacitances to digital values. |
| Setup time | Period required to prepare a device, machine, process, or system for it to be ready to function. |
| Signal-to-noise ratio | The ratio between a capacitive finger signal and system noise. |
| SPI | Serial peripheral interface is a synchronous serial data link standard. |

Document History Page

| Document Title: CYRF89435, P _{RoC} ™ - CapSense® Document Number: 001-76581 | | | | |
|---|---------|-----------------|-----------------|--|
| Revision | ECN | Orig. of Change | Submission Date | Description of Change |
| ** | 3545779 | ANTG | 03/13/2012 | New silicon document |
| *A | 3591949 | ANTG | 05/14/2012 | Modified title. Updated status "Company Confidential" of the datasheet. Changed "P _{RoC} NL - CapSense" to "P _{RoC} -CS" everywhere in the datasheet. Updated the Electrical Specifications. Updated the RF specifications. |
| *B | 3714928 | AKHL | 08/16/2012 | Major text update. Updated the pinout (Figure 3). |
| *C | 3747532 | AKHL | 09/25/2012 | Removed "Company Confidential" tag in the header. Replaced package diagram spec with 001-13190. |
| *D | 3784571 | AKHL | 10/18/2012 | Updated PSoC® Functional Overview (Added Transmit Power Control). Updated Electrical Specifications – RF Section (Replaced CYRF8935 with CYRF89435 in Figure 12 and also in the last bullet point below Figure 13). Updated Development Tool Selection (Updated Evaluation Tools (Removed "CY8CKIT-002 - MiniProg 3"), updated Device Programmers (Removed "CY3207ISSP In-System Serial Programmer (ISSP)", added the content from the removed section "CY8CKIT-002 - MiniProg 3" with slight modification). Updated in new template. |

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