



# THE DATASHEET OF CY8C4147AZE-S475



# Automotive PSoC™ 4: PSoC™ 4100S Plus

Based on Arm® Cortex®-M0+ CPU

## General description

PSoC™ 4 is a scalable and reconfigurable platform architecture for a family of programmable embedded system controllers with an Arm® Cortex®-M0+ CPU while being AEC-Q100 compliant. It combines programmable and reconfigurable analog and digital blocks with flexible automatic routing. PSoC™ 4100S Plus is a member of the PSoC™ 4 platform architecture. It is a combination of a microcontroller with standard communication and timing peripherals, a capacitive touch-sensing system (CAPSENSE™) with best-in-class performance, programmable general-purpose continuous-time and switched-capacitor analog blocks, and programmable connectivity. PSoC™ 4100S Plus products will be upward compatible with members of the PSoC™ 4 platform for new applications and design needs.

## Features

- Automotive Electronics Council (AEC) AEC-Q100 Qualified
- 32-bit MCU subsystem
  - 48-MHz Arm® Cortex®-M0+ CPU
  - Up to 128 KB of flash with Read Accelerator
  - Up to 16 KB of SRAM
  - 8-channel DMA engine
- Programmable analog
  - Two opamps with reconfigurable high-drive external and high-bandwidth internal drive and comparator modes and ADC input buffering capability. Opamps can operate in Deep Sleep low-power mode.
  - 12-bit 1-Msps SAR ADC with differential and single-ended modes, and channel sequencer with signal averaging
  - Single-slope 10-bit ADC function provided by a capacitance sensing block
  - Two current DACs (IDACs) for general-purpose or capacitive sensing applications on any pin
  - Two low-power comparators that operate in Deep Sleep low-power mode
- Programmable digital
  - Programmable logic blocks allowing Boolean operations to be performed on port inputs and outputs
- Low-power 1.71 V to 5.5 V operation
  - Deep Sleep mode with operational analog and 2.5 µA digital system current
- Capacitive sensing
  - Capacitive sigma-delta (CSD) provides best-in-class signal-to-noise ratio (SNR) (> 5:1) and water tolerance
  - Infineon-supplied software component makes capacitive sensing design easy
  - Automatic hardware tuning (SmartSense)
- LCD drive capability
  - LCD segment drive capability on GPIOs
- Serial communication
  - Five independent run-time reconfigurable serial communication blocks (SCBs) with re-configurable I<sup>2</sup>C, SPI, UART functionality, or LIN slave functionality
- Timing and pulse-width modulation
  - Eight 16-bit timer/counter/pulse-width modulator (TCPWM) blocks
  - Center-aligned, Edge, and Pseudo-random modes
  - Comparator-based triggering of Kill signals for motor drive and other high-reliability digital logic applications
  - Quadrature decoder

## Features

- Clock sources
  - 4 to 33 MHz external crystal oscillator (ECO)
  - PLL to generate 48-MHz frequency
  - 32-kHz watch crystal oscillator (WCO)
  - $\pm 2\%$  internal main oscillator (IMO)
  - 32-kHz internal low-power oscillator (ILO)
- True random number generator (TRNG)
  - TRNG generates truly random number for secure key generation for cryptography applications
- CAN block
  - CAN 2.0B block with support for time-triggered CAN (TTCAN)
- Temperature range
  - Grade-A:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
  - Grade-S:  $-40^{\circ}\text{C}$  to  $+105^{\circ}\text{C}$
  - Grade-E:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Up to 54 programmable GPIO pins
  - 40-pin QFN, 64-pin QFN, and 64-pin TQFP packages
  - Any GPIO pin can be CAPSENSE™, analog, or digital
  - Drive modes, strengths, and slew rates are programmable
- PSoC™ Creator design environment
  - Integrated development environment (IDE) provides schematic design entry and build (with analog and digital automatic routing)
  - Applications programming interface (API) component for all fixed-function and programmable peripherals
- Industry-standard tool compatibility
  - After schematic entry, development can be done with Arm®-based industry-standard development tools

More information

## More information

Infineon provides a wealth of data at [www.infineon.com](http://www.infineon.com) to help you to select the right PSoC™ device for your design, and to help you to quickly and effectively integrate the device into your design. For a comprehensive list of resources, see the knowledge base article [How to design with PSoC™ 3, PSoC™ 4, and PSoC™ 5LP - KBA86521](#). Following is an abbreviated list for PSoC™ 4:

- Overview: [PSoC™ portfolio](#)
- Product selectors: [PSoC™ 1](#), [PSoC™ 3](#), [PSoC™ 4](#), [PSoC™ 5LP](#)  
In addition, PSoC™ Creator includes a device selection tool.
- Application notes: Infineon offers a large number of PSoC™ application notes covering a broad range of topics, from basic to advanced level. Recommended application notes for getting started with PSoC™ 4 are:
  - [AN79953](#): Getting started With PSoC™ 4
  - [AN88619](#): PSoC™ 4 hardware design considerations
  - [AN86439](#): Using PSoC™ 4 GPIO pins
  - [AN57821](#): Mixed signal circuit board layout
  - [AN81623](#): Digital design best practices
  - [AN73854](#): Introduction to bootloaders
  - [AN89610](#): Arm® Cortex® code optimization
  - [AN85951](#): PSoC™ 4 and PSoC™ analog coprocessor CAPSENSE™ design guide
- Technical reference manual (TRM) is in two documents:
  - [Architecture TRM](#) details each PSoC™ 4 functional block.
  - [Registers TRM](#) describes each of the PSoC™ 4 registers.
- Development kits:
  - [CY8CKIT-041-41XX](#) PSoC™ 4100S CAPSENSE™ Pioneer Kit, is an easy-to-use and inexpensive development platform. This kit includes connectors for Arduino™ compatible shields.
  - [CY8CKIT-149](#) PSoC™ 4100S Plus prototyping kit enables you to evaluate and develop with Infineon's fourth-generation, low-power CAPSENSE™ solution using the PSoC™ 4100S Plus devices.

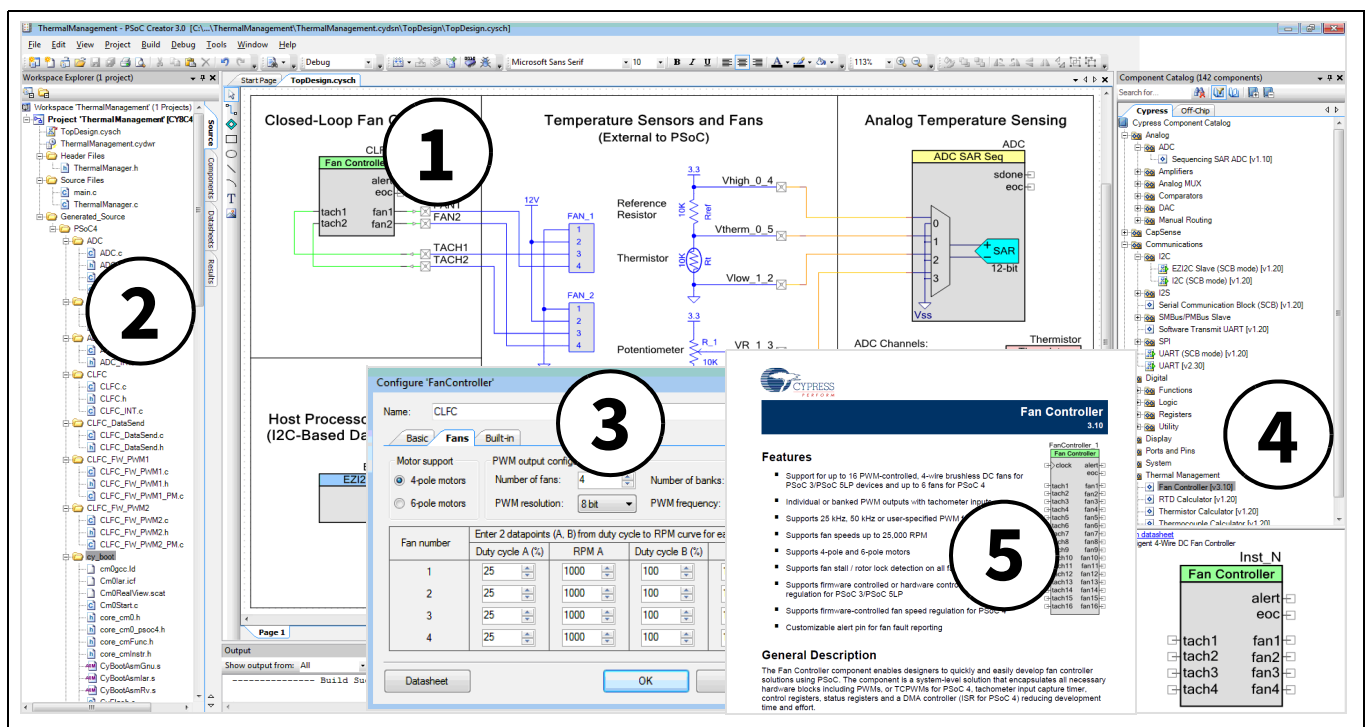
The [MiniProg3](#) device provides an interface for flash programming and debug.

- **Software user guide:**
  - A step-by-step guide for using PSoC™ Creator. The software user guide shows you how the PSoC™ Creator build process works in detail, how to use source control with PSoC™ Creator, and much more.
- Component datasheets:
  - The flexibility of PSoC™ allows the creation of new peripherals (components) long after the device has gone into production. Component datasheets provide all the information needed to select and use a particular component, including a functional description, API documentation, example code, and AC/DC specifications.
- Online:
  - In addition to print documentation, the [Infineon community page](#) connects you with fellow PSoC™ users and experts in PSoC™ from around the world, 24 hours a day, 7 days a week.

## PSoC™ Creator

**PSoC™ Creator** is a free Windows-based integrated design environment (IDE). It enables concurrent hardware and firmware design of PSoC™ 3, PSoC™ 4, and PSoC™ 5LP based systems. Create designs using classic, familiar schematic capture supported by over 100 pre-verified, production-ready PSoC™ Components; see the [list of component datasheets](#). With PSoC™ Creator, you can:

1. Drag and drop component icons to build your hardware system design in the main design workspace
2. Codesign your application firmware with the PSoC™ hardware, using the PSoC™ Creator IDE C compiler
3. Configure components using the configuration tools
4. Explore the library of 100+ components
5. Review component datasheets



**Figure 1 Multiple-sensor example project in PSoC™ Creator**

## Table of contents

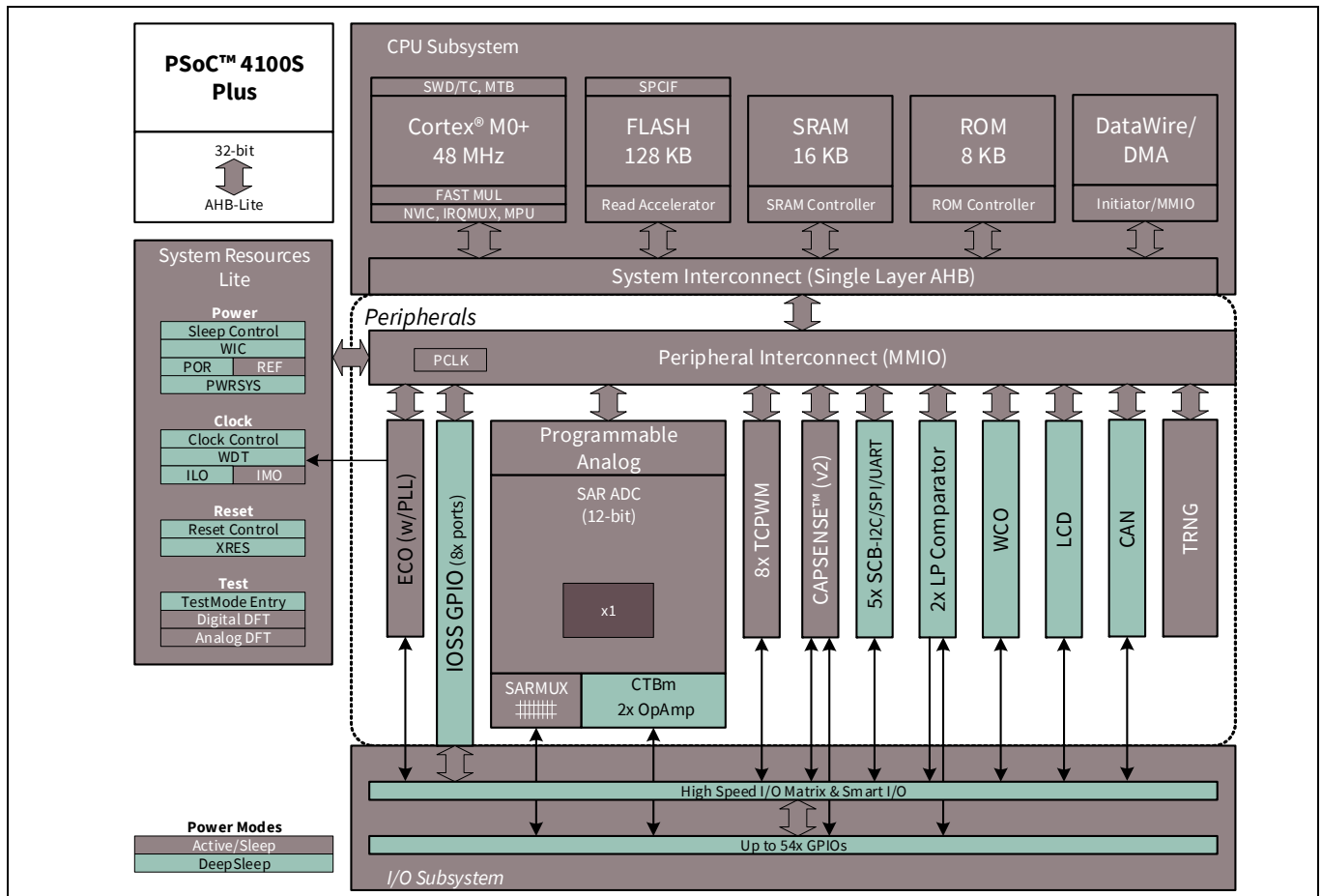
|   |           |
|---|-----------|
| <b>General description</b> .....                    | <b>1</b>  |
| <b>Features</b> .....                               | <b>1</b>  |
| <b>More information</b> .....                       | <b>3</b>  |
| <b>PSoC™ Creator</b> .....                          | <b>4</b>  |
| <b>Table of contents</b> .....                      | <b>5</b>  |
| <b>Block diagram</b> .....                          | <b>7</b>  |
| <b>1 Functional definition</b> .....                | <b>8</b>  |
| 1.1 CPU and memory subsystem .....                  | 8         |
| 1.1.1 CPU .....                                     | 8         |
| 1.1.2 Flash .....                                   | 8         |
| 1.1.3 SRAM .....                                    | 8         |
| 1.1.4 SROM .....                                    | 8         |
| 1.2 System resources .....                          | 8         |
| 1.2.1 Power system .....                            | 8         |
| 1.2.2 Clock system .....                            | 9         |
| 1.2.3 IMO clock source .....                        | 9         |
| 1.2.4 ILO clock source .....                        | 9         |
| 1.2.5 WCO .....                                     | 10        |
| 1.2.6 ECO .....                                     | 10        |
| 1.2.7 WDT .....                                     | 10        |
| 1.2.8 Reset .....                                   | 10        |
| 1.3 Analog blocks .....                             | 10        |
| 1.3.1 12-bit SAR ADC .....                          | 10        |
| 1.3.2 Two opamps (continuous-time block; CTB) ..... | 11        |
| 1.3.3 Low-power comparators (LPC) .....             | 11        |
| 1.3.4 Current DACs .....                            | 11        |
| 1.3.5 Analog multiplexed buses .....                | 11        |
| 1.4 Programmable digital blocks .....               | 11        |
| 1.4.1 Smart I/O block .....                         | 11        |
| 1.5 Fixed function digital blocks .....             | 12        |
| 1.5.1 Timer/counter/PWM (TCPWM) block .....         | 12        |
| 1.5.2 Serial Communication Block (SCB) .....        | 12        |
| 1.5.3 CAN .....                                     | 12        |
| 1.6 GPIO .....                                      | 13        |
| 1.7 Special function peripherals .....              | 13        |
| 1.7.1 CAPSENSE™ .....                               | 13        |
| 1.7.2 LCD segment drive .....                       | 13        |
| <b>2 Pinouts</b> .....                              | <b>14</b> |
| 2.1 Alternate pin functions .....                   | 19        |
| <b>3 Power</b> .....                                | <b>23</b> |
| 3.1 Mode 1: 1.8 V to 5.5 V external supply .....    | 23        |
| 3.2 Mode 2: 1.8 V ± 5% external supply .....        | 23        |
| <b>4 Electrical specifications</b> .....            | <b>25</b> |
| 4.1 Absolute maximum ratings .....                  | 25        |
| 4.2 Device-level specifications .....               | 26        |
| 4.2.1 GPIO .....                                    | 27        |
| 4.2.2 XRES .....                                    | 29        |
| 4.3 Analog peripherals .....                        | 30        |
| 4.3.1 CTBm opamp .....                              | 30        |
| 4.3.2 Comparator .....                              | 34        |
| 4.3.3 Temperature sensor .....                      | 35        |

Table of contents

|   |           |
|---|-----------|
| 4.3.4 SAR ADC .....                                     | 35        |
| 4.3.5 CSD and IDAC .....                                | 36        |
| 4.3.6 10-bit CAPSENSE™ ADC.....                         | 39        |
| 4.4 Digital peripherals.....                            | 40        |
| 4.4.1 Timer counter pulse-width modulator (TCPWM) ..... | 40        |
| 4.4.2 I <sup>2</sup> C .....                            | 41        |
| 4.4.3 SPI.....  | 42        |
| 4.4.4 UART .....  | 43        |
| 4.4.5 LCD Direct Drive .....                            | 43        |
| 4.5 Memory.....   | 44        |
| 4.5.1 Flash .....                                       | 44        |
| 4.6 System resources.....                               | 45        |
| 4.6.1 Power-on reset (POR) .....                        | 45        |
| 4.6.2 Brown-out detect (BOD) .....                      | 45        |
| 4.6.3 SWD interface.....                                | 45        |
| 4.6.4 Internal main oscillator .....                    | 46        |
| 4.6.5 Internal low-speed oscillator .....               | 47        |
| 4.6.6 Watch crystal oscillator (WCO) .....              | 47        |
| 4.6.7 External clock.....                               | 47        |
| 4.6.8 External crystal oscillator and PLL.....          | 48        |
| 4.6.9 System clock .....                                | 49        |
| 4.6.10 Smart I/O .....                                  | 49        |
| 4.6.11 CAN .....  | 49        |
| <b>5 Ordering information .....</b>                     | <b>50</b> |
| <b>6 Packaging .....</b>                                | <b>60</b> |
| 6.1 Package diagrams.....                               | 61        |
| <b>7 Acronyms.....</b>                                  | <b>65</b> |
| <b>8 Document conventions.....</b>                      | <b>69</b> |
| 8.1 Units of measure .....                              | 69        |
| <b>Revision history .....</b>                           | <b>70</b> |

Block diagram

## Block diagram



PSoC™ 4100S Plus devices include extensive support for programming, testing, debugging, and tracing both hardware and firmware.

The Arm® serial-wire debug (SWD) interface supports all programming and debug features of the device.

Complete debug-on-chip functionality enables full-device debugging in the final system using the standard production device. It does not require special interfaces, debugging pods, simulators, or emulators. Only the standard programming connections are required to fully support debug.

The PSoC™ Creator IDE provides fully integrated programming and debug support for the PSoC™ 4100S Plus devices. The SWD interface is fully compatible with industry-standard third-party tools. PSoC™ 4100S Plus provides a level of security not possible with multi-chip application solutions or with microcontrollers. It has the following advantages:

- Allows disabling of debug features
- Robust flash protection
- Allows customer-proprietary functionality to be implemented in on-chip programmable blocks

The debug circuits are enabled by default and can be disabled in firmware. If they are not enabled, the only way to re-enable them is to erase the entire device, clear flash protection, and reprogram the device with new firmware that enables debugging. Thus firmware control of debugging cannot be over-riden without erasing the firmware thus providing security.

Additionally, all device interfaces can be permanently disabled (device security) for applications concerned about phishing attacks due to a maliciously reprogrammed device or attempts to defeat security by starting and interrupting flash programming sequences. All programming, debug, and test interfaces are disabled when maximum device security is enabled. Therefore, PSoC™ 4100S Plus, with device security enabled, may not be returned for failure analysis. This is a trade-off the PSoC™ 4100S Plus allows the customer to make.

## **1 Functional definition**

### **1.1 CPU and memory subsystem**

#### **1.1.1 CPU**

The Cortex®-M0+ CPU in the PSoC™ 4100S Plus is part of the 32-bit MCU subsystem, which is optimized for low-power operation with extensive clock gating. Most instructions are 16 bits in length and the CPU executes a subset of the Thumb-2 instruction set. It includes a nested vectored interrupt controller (NVIC) block with eight interrupt inputs and also includes a Wakeup Interrupt Controller (WIC). The WIC can wake the processor from Deep Sleep mode, allowing power to be switched off to the main processor when the chip is in Deep Sleep mode. The CPU subsystem includes an 8-channel DMA engine and also includes a debug interface, the SWD interface, which is a 2-wire form of JTAG. The debug configuration used for PSoC™ 4100S Plus has four breakpoint (address) comparators and two watchpoint (data) comparators.

#### **1.1.2 Flash**

The PSoC™ 4100S Plus device has a flash module with a flash accelerator, tightly coupled to the CPU to improve average access times from the flash block. The low-power flash block is designed to deliver two wait-state (WS) access time at 48 MHz. The flash accelerator delivers 85% of single-cycle SRAM access performance on average.

#### **1.1.3 SRAM**

16 KB of SRAM are provided with zero wait-state access at 48 MHz.

#### **1.1.4 SRAM**

An 8-KB supervisory ROM that contains boot and configuration routines is provided.

### **1.2 System resources**

#### **1.2.1 Power system**

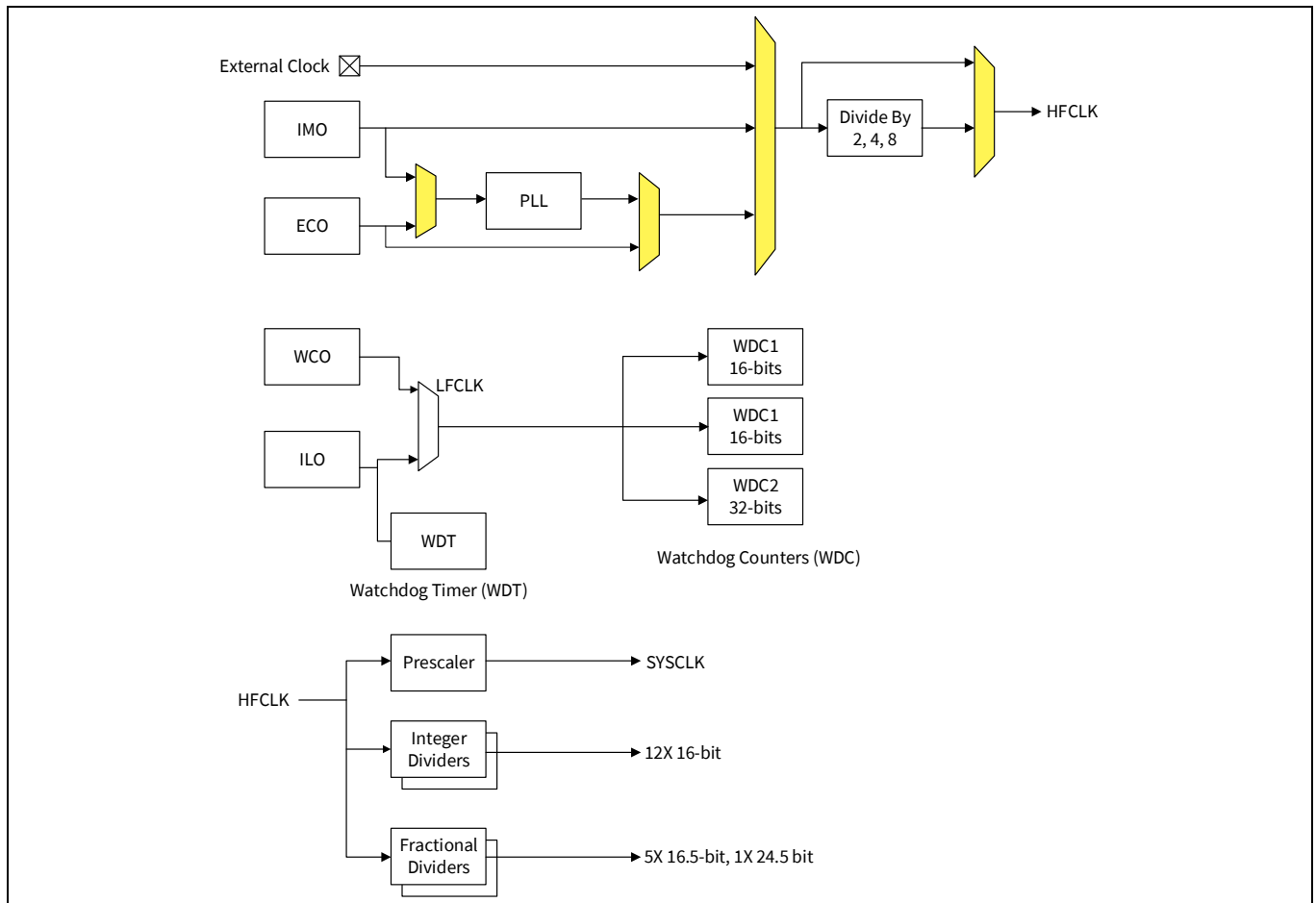
The power system is described in detail in the section **“Power”** on page 23. It provides assurance that voltage levels are as required for each respective mode and either delays mode entry (for example, on power-on reset (POR)) until voltage levels are as required for proper functionality, or generates resets (for example, on brownout detection). PSoC™ 4100S Plus operates with a single external supply over the range of either 1.8 V ± 5% (externally regulated) or 1.8 V to 5.5 V (internally regulated) and has three different power modes, transitions between which are managed by the power system. PSoC™ 4100S Plus provides Active, Sleep, and Deep Sleep low-power modes.

All subsystems are operational in Active mode. The CPU subsystem (CPU, flash, and SRAM) is clock-gated off in Sleep mode, while all peripherals and interrupts are active with instantaneous wake-up on a wake-up event. In Deep Sleep mode, the high-speed clock and associated circuitry is switched off; wake-up from this mode takes 35 μs. The opamps can remain operational in Deep Sleep mode.

## 1.2.2 Clock system

The PSoC™ 4100S Plus clock system is responsible for providing clocks to all subsystems that require clocks and for switching between different clock sources without glitching. In addition, the clock system ensures that there are no metastable conditions.

The clock system for the PSoC™ 4100S Plus consists of the IMO, ILO, a 32-kHz watch crystal oscillator (WCO), MHz ECO and PLL, and provision for an external clock. The WCO block allows locking the IMO to the 32-kHz oscillator.



**Figure 2 PSoC™ 4100S Plus MCU clocking architecture**

The HFCLK signal can be divided down as shown to generate synchronous clocks for the Analog and Digital peripherals. There are 18 clock dividers for the PSoC™ 4100S Plus (six with fractional divide capability, twelve with integer divide only). The twelve 16-bit integer divide capability allows a lot of flexibility in generating fine-grained frequency. In addition, there are five 16-bit fractional dividers and one 24-bit fractional divider.

### 1.2.3 IMO clock source

The IMO is the primary source of internal clocking in the PSoC™ 4100S Plus. It is trimmed during testing to achieve the specified accuracy. The IMO default frequency is 24 MHz and it can be adjusted from 24 to 48 MHz in steps of 4 MHz. The IMO tolerance with Infineon-provided calibration settings is  $\pm 2\%$  over the entire voltage and temperature range.

### 1.2.4 ILO clock source

The ILO is a very low power, nominally 40-kHz oscillator, which is primarily used to generate clocks for the watchdog timer (WDT) and peripheral operation in Deep Sleep mode. ILO-driven counters can be calibrated to the IMO to improve accuracy. Infineon provides a software component, which does the calibration.

### 1.2.5 WCO

The PSoC™ 4100S Plus clock subsystem also implements a low-frequency (32-kHz watch crystal) oscillator that can be used for precision timing applications.

### 1.2.6 ECO

The PSoC™ 4100S Plus also implements a 4 MHz to 33 MHz crystal oscillator.

### 1.2.7 WDT

A watchdog timer is implemented in the clock block running from the ILO; this allows watchdog operation during Deep Sleep and generates a watchdog reset if not serviced before the set timeout occurs. The watchdog reset is recorded in a Reset Cause register, which is firmware readable.

### 1.2.8 Reset

PSoC™ 4100S Plus can be reset from a variety of sources including a software reset. Reset events are asynchronous and guarantee reversion to a known state. The reset cause is recorded in a register, which is sticky through reset and allows software to determine the cause of the reset. An XRES pin is reserved for external reset by asserting it active low. The XRES pin has an internal pull-up resistor that is always enabled.

## 1.3 Analog blocks

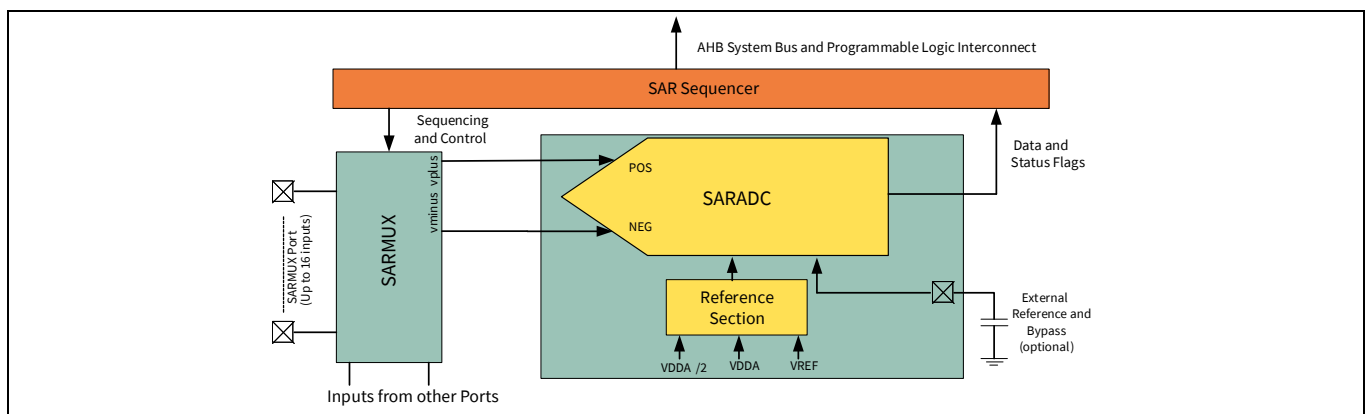
### 1.3.1 12-bit SAR ADC

The 12-bit, 1-Msps SAR ADC can operate at a maximum clock rate of 18 MHz and requires a minimum of 18 clocks at that frequency to do a 12-bit conversion.

The sample-and-hold (S/H) aperture is programmable allowing the gain bandwidth requirements of the amplifier driving the SAR inputs, which determine its settling time, to be relaxed if required. It is possible to provide an external bypass (through a fixed pin location) for the internal reference amplifier.

The SAR is connected to a fixed set of pins through an 8-input sequencer. The sequencer cycles through selected channels autonomously (sequencer scan) with zero switching overhead (that is, aggregate sampling bandwidth is equal to 1 Msps whether it is for a single channel or distributed over several channels). The sequencer switching is effected through a state machine or through firmware driven switching. A feature provided by the sequencer is buffering of each channel to reduce CPU interrupt service requirements. To accommodate signals with varying source impedance and frequency, it is possible to have different sample times programmable for each channel. Also, signal range specification through a pair of range registers (low and high range values) is implemented with a corresponding out-of-range interrupt if the digitized value exceeds the programmed range; this allows fast detection of out-of-range values without the necessity of having to wait for a sequencer scan to be completed and the CPU to read the values and check for out-of-range values in software.

The SAR is not available in Deep Sleep mode as it requires a high-speed clock (up to 18 MHz). The SAR operating range is 1.71 V to 5.5 V.



**Figure 3 SAR ADC**

### **1.3.2 Two opamps (continuous-time block; CTB)**

PSoC™ 4100S Plus has two opamps with Comparator modes which allow most common analog functions to be performed on-chip eliminating external components; PGAs, voltage buffers, filters, trans-impedance amplifiers, and other functions can be realized, in some cases with external passives. saving power, cost, and space. The on-chip opamps are designed with enough bandwidth to drive the sample-and-hold circuit of the ADC without requiring external buffering.

### **1.3.3 Low-power comparators (LPC)**

PSoC™ 4100S Plus has a pair of low-power comparators, which can also operate in Deep Sleep modes. This allows the analog system blocks to be disabled while retaining the ability to monitor external voltage levels during low-power modes. The comparator outputs are normally synchronized to avoid metastability unless operating in an asynchronous power mode where the system wake-up circuit is activated by a comparator switch event. The LPC outputs can be routed to pins.

### **1.3.4 Current DACs**

PSoC™ 4100S Plus has two IDACs, which can drive any of the pins on the chip. These IDACs have programmable current ranges.

### **1.3.5 Analog multiplexed buses**

PSoC™ 4100S Plus has two concentric independent buses that go around the periphery of the chip. These buses (called amux buses) are connected to firmware-programmable analog switches that allow the chip's internal resources (IDACs, comparator) to connect to any pin on the I/O ports.

## **1.4 Programmable digital blocks**

### **1.4.1 Smart I/O block**

The Smart I/O block is a fabric of switches and LUTs that allows Boolean functions to be performed in signals being routed to the pins of a GPIO port. The Smart I/O can perform logical operations on input pins to the chip and on signals going out as outputs.

## 1.5 Fixed function digital blocks

### 1.5.1 Timer/counter/PWM (TCPWM) block

The TCPWM block consists of a 16-bit counter with user-programmable period length. There is a capture register to record the count value at the time of an event (which may be an I/O event), a period register that is used to either stop or auto-reload the counter when its count is equal to the period register, and compare registers to generate compare value signals that are used as PWM duty cycle outputs. The block also provides true and complementary outputs with programmable offset between them to allow use as dead-band programmable complementary PWM outputs. It also has a Kill input to force outputs to a predetermined state; for example, this is used in motor drive systems when an over-current state is indicated and the PWM driving the FETs needs to be shut off immediately with no time for software intervention. Each block also incorporates a quadrature decoder. There are eight TCPWM blocks in PSoC™ 4100S Plus.

### 1.5.2 Serial Communication Block (SCB)

PSoC™ 4100S Plus has five serial communication blocks, which can be programmed to have SPI, I<sup>2</sup>C, UART, or LIN Slave functionality.

**I<sup>2</sup>C mode:** The hardware I<sup>2</sup>C block implements a full multi-master and slave interface (it is capable of multi-master arbitration). This block is capable of operating at speeds of up to 1 Mbps (Fast Mode Plus) and has flexible buffering options to reduce interrupt overhead and latency for the CPU. It also supports EZI<sup>2</sup>C that creates a mailbox address range in the memory of PSoC™ 4100S Plus and effectively reduces I<sup>2</sup>C communication to reading from and writing to an array in memory. In addition, the block supports an 8-deep FIFO for receive and transmit which, by increasing the time given for the CPU to read data, greatly reduces the need for clock stretching caused by the CPU not having read data on time.

The I<sup>2</sup>C peripheral is compatible with the I<sup>2</sup>C Standard-mode and Fast-mode Plus devices as defined in the NXP I<sup>2</sup>C-bus specification and user manual (UM10204). The I<sup>2</sup>C bus I/O is implemented with GPIO in open-drain modes.

PSoC™ 4100S Plus is not completely compliant with the I<sup>2</sup>C spec in the following respect:

- GPIO cells are not over-voltage tolerant and, therefore, cannot be hot-swapped or powered up independently of the rest of the I<sup>2</sup>C system.

**UART mode:** This is a full-feature UART operating at up to 1 Mbps. It supports automotive single-wire interface (LIN), infrared interface (IrDA), and SmartCard (ISO7816) protocols, all of which are minor variants of the basic UART protocol. In addition, it supports the 9-bit multiprocessor mode that allows addressing of peripherals connected over common RX and TX lines. Common UART functions such as parity error, break detect, and frame error are supported. An 8-deep FIFO allows much greater CPU service latencies to be tolerated.

**SPI mode:** The SPI mode supports full Motorola SPI, TI SSP (adds a start pulse used to synchronize SPI Codecs), and National Microwire (half-duplex form of SPI). The SPI block can use the FIFO.

**LIN Slave mode:** The LIN slave mode uses the SCB hardware block and implements a full LIN slave interface. This LIN slave is compliant with LIN v1.3, v2.1/2.2, ISO 17987-6, and SAE J2602-2 specification standards. It is certified by C&S GmbH based on the standard protocol and data link layer conformance tests. LIN slave can be operated at baud rates of up to ~20 Kbps with a maximum of 40-meter cable length. The PSoC™ Creator software supports up to two LIN slave interfaces in the PSoC™ 4 device, providing built-in application programming interfaces (APIs) based on the LIN specification standard.

### 1.5.3 CAN

There is one CAN block, which implements CAN 2.0B as defined in the Bosch specifications and conform to the ISO-11898-1 standard.

## 1.6 GPIO

PSoC™ 4100S Plus has up to 54 GPIOs. The GPIO block implements the following:

- Eight drive modes:
  - Analog input mode (input and output buffers disabled)
  - Input only
  - Weak pull-up with strong pull-down
  - Strong pull-up with weak pull-down
  - Open drain with strong pull-down
  - Open drain with strong pull-up
  - Strong pull-up with strong pull-down
  - Weak pull-up with weak pull-down
- Input threshold select (CMOS or LVTTTL).
- Individual control of input and output buffer enabling/disabling in addition to the drive strength modes
- Selectable slew rates for dV/dt related noise control to improve EMI

The pins are organized in logical entities called ports, which are 8-bit in width (less for Ports 5 and 6). During power-on and reset, the blocks are forced to the disabled state so as not to crowbar any inputs and/or cause excess turn-on current. A multiplexing network known as a high-speed I/O matrix is used to multiplex between various signals that may connect to an I/O pin.

Data output and pin state registers store, respectively, the values to be driven on the pins and the states of the pins themselves.

Every I/O pin can generate an interrupt if so enabled and each I/O port has an interrupt request (IRQ) and interrupt service routine (ISR) vector associated with it.

## 1.7 Special function peripherals

### 1.7.1 CAPSENSE™

CAPSENSE™ is supported in the PSoC™ 4100S Plus through a CAPSENSE™ sigma-delta (CSD) block that can be connected to any pins through an analog multiplex bus via analog switches. CAPSENSE™ function can thus be provided on any available pin or group of pins in a system under software control. A PSoC™ Creator component is provided for the CAPSENSE™ block to make it easy for the user.

Shield voltage can be driven on another analog multiplex bus to provide water-tolerance capability. Water tolerance is provided by driving the shield electrode in phase with the sense electrode to keep the shield capacitance from attenuating the sensed input. Proximity sensing can also be implemented.

The CAPSENSE™ block has two IDACs, which can be used for general purposes if CAPSENSE™ is not being used (both IDACs are available in that case) or if CAPSENSE™ is used without water tolerance (one IDAC is available).

The CAPSENSE™ block also provides a 10-bit Slope ADC function which can be used in conjunction with the CAPSENSE™ function.

The CAPSENSE™ block is an advanced, low-noise, programmable block with programmable voltage references and current source ranges for improved sensitivity and flexibility. It can also use an external reference voltage. It has a full-wave CSD mode that alternates sensing to VDDA and ground to null out power-supply related noise.

### 1.7.2 LCD segment drive

PSoC™ 4100S Plus has an LCD controller, which can drive up to 4 commons and up to 50 segments. It uses full digital methods to drive the LCD segments requiring no generation of internal LCD voltages. The two methods used are referred to as Digital Correlation and PWM. Digital Correlation pertains to modulating the frequency and drive levels of the common and segment signals to generate the highest RMS voltage across a segment to light it up or to keep the RMS signal to zero. This method is good for STN displays but may result in reduced contrast with TN (cheaper) displays. PWM pertains to driving the panel with PWM signals to effectively use the capacitance of the panel to provide the integration of the modulated pulse-width to generate the desired LCD voltage. This method results in higher power consumption but can result in better results when driving TN displays. LCD operation is supported during Deep Sleep refreshing a small display buffer (4 bits; one 32-bit register per port).

## 2 Pinouts

**Table 1** 48-pin QFN package pin list

| Pin | Name |
|-----|------|
| 28  | P0.0 |
| 29  | P0.1 |
| 30  | P0.2 |
| 31  | P0.3 |
| 32  | P0.4 |
| 33  | P0.5 |
| 34  | P0.6 |
| 35  | P0.7 |
| 36  | XRES |
| 37  | VCCD |
| 38  | VCCD |
| 39  | VDDD |
| 40  | VDDA |
| 41  | VSSA |
| 42  | P1.0 |
| 43  | P1.1 |
| 44  | P1.2 |
| 45  | P1.3 |
| 46  | P1.4 |
| 47  | P1.5 |
| 48  | P1.6 |
| 1   | P1.7 |
| 2   | P2.0 |
| 3   | P2.1 |
| 4   | P2.2 |
| 5   | P2.3 |
| 6   | P2.4 |
| 7   | P2.5 |
| 8   | P2.6 |
| 9   | P2.7 |
| 10  | P6.1 |
| 11  | P6.2 |
| 12  | VSSD |
| 13  | P3.0 |
| 14  | P3.1 |
| 15  | P3.2 |
| 16  | P3.3 |

Pinouts

**Table 1**      **48-pin QFN package pin list** *(continued)*

| Pin | Name |
|-----|------|
| 17  | P3.4 |
| 18  | P3.5 |
| 19  | P3.6 |
| 20  | P3.7 |
| 21  | VDDD |
| 22  | P4.0 |
| 23  | P4.1 |
| 24  | P4.2 |
| 25  | P4.3 |
| 26  | P7.0 |
| 27  | P7.1 |

**Table 2**      **40-pin QFN package pin list**

| Pin | Name      |
|-----|-----------|
| 22  | P0.0      |
| 23  | P0.1      |
| 24  | P0.2      |
| 25  | P0.3      |
| 26  | P0.4      |
| 27  | P0.5      |
| 28  | P0.6      |
| 29  | P0.7      |
| 30  | XRES      |
| 31  | VCCD      |
| 32  | VSSD      |
| 33  | VDD       |
| 34  | VSSA      |
| 35  | P1.0      |
| 36  | P1.1      |
| 37  | P1.2      |
| 38  | P1.3      |
| 39  | P1.4      |
| 40  | P1.7/VREF |
| 1   | P2.3      |
| 2   | P2.4      |
| 3   | P2.5      |
| 4   | P2.6      |
| 5   | P2.7      |
| 6   | P6.0      |

Pinouts

**Table 2**      **40-pin QFN package pin list** *(continued)*

| <b>Pin</b> | <b>Name</b> |
|------------|-------------|
| 7          | P6.1        |
| 8          | P6.2        |
| 9          | VSSD        |
| 10         | P3.0        |
| 11         | P3.1        |
| 12         | P3.2        |
| 13         | P3.3        |
| 14         | P3.4        |
| 15         | P3.5        |
| 16         | P3.6        |
| 17         | P3.7        |
| 18         | P4.0        |
| 19         | P4.1        |
| 20         | P4.2        |
| 21         | P4.3        |

Pinouts

**Table 3**      **64-pin QFN and 64-pin TQFP packages pin list**

| <b>Pin</b> | <b>Name</b>     |
|------------|-----------------|
| 39         | P0.0            |
| 40         | P0.1            |
| 41         | P0.2            |
| 42         | P0.3            |
| 43         | P0.4            |
| 44         | P0.5            |
| 45         | P0.6            |
| 46         | P0.7            |
| 47         | XRES            |
| 48         | VCCD            |
| 49         | VSSD            |
| 50         | VDDD            |
| 51         | P5.0            |
| 52         | P5.1            |
| 53         | P5.2            |
| 54         | P5.3            |
| 55         | P5.5            |
| 56         | VDDA            |
| 57         | VSSA            |
| 58         | P1.0            |
| 59         | P1.1            |
| 60         | P1.2            |
| 61         | P1.3            |
| 62         | P1.4            |
| 63         | P1.5            |
| 64         | P1.6            |
| 1          | P1.7            |
| 2          | P2.0            |
| 3          | P2.1            |
| 4          | P2.2            |
| 5          | P2.3            |
| 6          | P2.4            |
| 7          | P2.5            |
| 8          | P2.6            |
| 9          | P2.7            |
| 10         | VSSD            |
| 11         | No Connect (NC) |
| 12         | P6.0            |
| 13         | P6.1            |

Pinouts

**Table 3**      **64-pin QFN and 64-pin TQFP packages pin list** *(continued)*

| Pin | Name |
|-----|------|
| 14  | P6.2 |
| 15  | P6.4 |
| 16  | P6.5 |
| 17  | VSSD |
| 18  | P3.0 |
| 19  | P3.1 |
| 20  | P3.2 |
| 21  | P3.3 |
| 22  | P3.4 |
| 23  | P3.5 |
| 24  | P3.6 |
| 25  | P3.7 |
| 26  | VDDD |
| 27  | P4.0 |
| 28  | P4.1 |
| 29  | P4.2 |
| 30  | P4.3 |
| 31  | P4.4 |
| 32  | P4.5 |
| 33  | P4.6 |
| 34  | P4.7 |
| 35  | P5.6 |
| 36  | P5.7 |
| 37  | P7.0 |
| 38  | P7.1 |

**Descriptions of the Power pins are as follows:**

VDDD: Power supply for the digital section.

VDDA: Power supply for the analog section.

VSSD, VSSA: Ground pins for the digital and analog sections respectively.

VCCD: Regulated digital supply (1.8 V ± 5%)

VDD: On some packages, VDDA and VDDD are shorted inside and brought out as a single power supply

**GPIOs:** 54

## 2.1 Alternate pin functions

Each port pin has can be assigned to one of multiple functions; it can, for example, be an analog I/O, a digital peripheral CAPSENSE™ pin. The pin assignments are shown in the following table.

**Table 4 Pin assignments**

| Port/Pin | Analog         | Smart I/O        | ACT #0                | ACT #1            | ACT #3            | DS #2            |
|----------|----------------|------------------|-----------------------|-------------------|-------------------|------------------|
| P0.0     | lpcomp.in_p[0] |                  |                       | tcpwm.tr_in[0]    | scb[2].uart_cts:0 | scb[2].i2c_scl:0 |
| P0.1     | lpcomp.in_n[0] |                  |                       | tcpwm.tr_in[1]    | scb[2].uart_rts:0 | scb[2].i2c_sda:0 |
| P0.2     | lpcomp.in_p[1] |                  |                       |                   |                   |                  |
| P0.3     | lpcomp.in_n[1] |                  |                       |                   |                   |                  |
| P0.4     | wco.wco_in     |                  |                       | scb[1].uart_rx:0  | scb[2].uart_rx:0  | scb[1].i2c_scl:0 |
| P0.5     | wco.wco_out    |                  |                       | scb[1].uart_tx:0  | scb[2].uart_tx:0  | scb[1].i2c_sda:0 |
| P0.6     | exco.eco_in    |                  | srss.ext_clk:0        | scb[1].uart_cts:0 | scb[2].uart_tx:1  |                  |
| P0.7     | exco.eco_out   |                  | tcpwm.line[0]:3       | scb[1].uart_rts:0 |                   |                  |
| P5.0     |                |                  | tcpwm.line[4]:2       |                   | scb[2].uart_rx:1  | scb[2].i2c_scl:1 |
| P5.1     |                |                  | tcpwm.line_comp[[4]:2 |                   | scb[2].uart_tx:2  | scb[2].i2c_sda:1 |
| P5.2     |                |                  | tcpwm.line[5]:2       |                   | scb[2].uart_cts:1 | lpcomp.comp[0]   |
| P5.3     |                |                  | tcpwm.line_comp[[5]:2 |                   | scb[2].uart_rts:1 | lpcomp.comp[1]   |
| P5.5     |                |                  | tcpwm.line_comp[[6]:2 |                   |                   |                  |
| P1.0     | ctb0_oa0+      | SmartIo[2].io[0] | tcpwm.line[2]:1       | scb[0].uart_rx:1  |                   | scb[0].i2c_scl:0 |
| P1.1     | ctb0_oa0-      | SmartIo[2].io[1] | tcpwm.line_comp[[2]:1 | scb[0].uart_tx:1  |                   | scb[0].i2c_sda:0 |

**Table 4** Pin assignments (continued)

| Port/Pin | Analog                                      | Smart I/O        | ACT #0               | ACT #1            | ACT #3             | DS #2            |
|----------|---|------------------|----------------------|-------------------|--------------------|------------------|
| P1.2     | ctb0_oa0_out                                | Smartio[2].io[2] | tcpwm.line[3]:1      | scb[0].uart_cts:1 | tcpwm.tr_in[2]     | scb[2].i2c_scl:1 |
| P1.3     | ctb0_oa1_out                                | Smartio[2].io[3] | tcpwm.line_comp[3]:1 | scb[0].uart_rts:1 | tcpwm.tr_in[3]     | scb[2].i2c_sda:2 |
| P1.4     | ctb0_oa1-                                   | Smartio[2].io[4] | tcpwm.line[6]:1      |                   |                    | scb[3].i2c_scl:0 |
| P1.5     | ctb0_oa1+                                   | Smartio[2].io[5] | tcpwm.line_comp[6]:1 |                   |                    | scb[3].i2c_sda:0 |
| P1.6     | ctb0_oa0+                                   | Smartio[2].io[6] | tcpwm.line[7]:1      |                   |                    |                  |
| P1.7     | ctb0_oa1+<br>sar_ext_vref0<br>sar_ext_vref1 | Smartio[2].io[7] | tcpwm.line_comp[7]:1 |                   |                    |                  |
| P2.0     | sarmux[0]                                   | Smartio[0].io[0] | tcpwm.line[4]:0      | csd.comp          | tcpwm.tr_in[4]     | scb[1].i2c_scl:1 |
| P2.1     | sarmux[1]                                   | Smartio[0].io[1] | tcpwm.line_comp[4]:0 |                   | tcpwm.tr_in[5]     | scb[1].i2c_sda:1 |
| P2.2     | sarmux[2]                                   | Smartio[0].io[2] | tcpwm.line[5]:1      |                   |                    |                  |
| P2.3     | sarmux[3]                                   | Smartio[0].io[3] | tcpwm.line_comp[5]:1 |                   |                    |                  |
| P2.4     | sarmux[4]                                   | Smartio[0].io[4] | tcpwm.line[0]:1      | scb[3].uart_rx:1  |                    |                  |
| P2.5     | sarmux[5]                                   | Smartio[0].io[5] | tcpwm.line_comp[0]:1 | scb[3].uart_tx:1  |                    |                  |
| P2.6     | sarmux[6]                                   | Smartio[0].io[6] | tcpwm.line[1]:1      | scb[3].uart_cts:1 |                    |                  |
| P2.7     | sarmux[7]                                   | Smartio[0].io[7] | tcpwm.line_comp[1]:1 | scb[3].uart_rts:1 |                    | lpcomp.comp[0]   |
| P6.0     |   |                  | tcpwm.line[4]:1      | scb[3].uart_rx:0  | can.can_tx_enb_n:0 | scb[3].i2c_scl:1 |
| P6.1     |   |                  | tcpwm.line_comp[4]:1 | scb[3].uart_tx:0  | can.can_rx:0       | scb[3].i2c_sda:1 |
| P6.2     |   |                  | tcpwm.line[5]:0      | scb[3].uart_cts:0 | can.can_tx:0       |                  |
| P6.4     |   |                  | tcpwm.line[6]:0      |                   |                    | scb[4].i2c_scl   |

**Table 4** Pin assignments (continued)

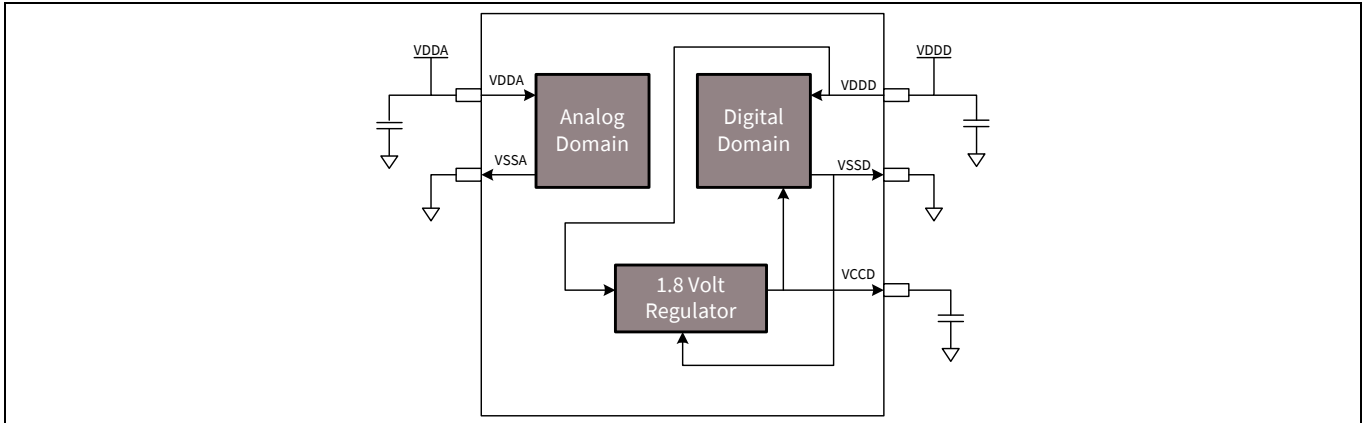
| Port/Pin | Analog       | Smart I/O        | ACT #0               | ACT #1            | ACT #3             | DS #2             |
|----------|--------------|------------------|----------------------|-------------------|--------------------|-------------------|
| P6.5     |              |                  | tcpwm.line_comp[6]:0 |                   |                    | scb[4].i2c_sda    |
| P3.0     |              | Smartio[1].io[0] | tcpwm.line[0]:0      | scb[1].uart_rx:1  |                    | scb[1].i2c_scl:2  |
| P3.1     |              | Smartio[1].io[1] | tcpwm.line_comp[0]:0 | scb[1].uart_tx:1  |                    | scb[1].i2c_sda:2  |
| P3.2     |              | Smartio[1].io[2] | tcpwm.line[1]:0      | scb[1].uart_cts:1 |                    | cpuss.swd_data    |
| P3.3     |              | Smartio[1].io[3] | tcpwm.line_comp[1]:0 | scb[1].uart_rts:1 |                    | cpuss.swd_clk     |
| P3.4     |              | Smartio[1].io[4] | tcpwm.line[2]:0      |                   | tcpwm.tr_in[6]     |                   |
| P3.5     |              | Smartio[1].io[5] | tcpwm.line_comp[2]:0 |                   |                    |                   |
| P3.6     |              | Smartio[1].io[6] | tcpwm.line[3]:0      |                   |                    | scb[4].spi_select |
| P3.7     |              | Smartio[1].io[7] | tcpwm.line_comp[3]:0 |                   |                    | lpcomp.comp[1]    |
| P4.0     | csd.vref_ext |                  |                      | scb[0].uart_rx:0  | can.can_rx:1       | scb[0].i2c_scl:1  |
| P4.1     | csd.cshield  |                  |                      | scb[0].uart_tx:0  | can.can_tx:1       | scb[0].i2c_sda:1  |
| P4.2     | csd.cmod     |                  |                      | scb[0].uart_cts:0 | can.can_tx_enb_n:1 | lpcomp.comp[0]    |
| P4.3     | csd.csh_tank |                  |                      | scb[0].uart_rts:0 |                    | lpcomp.comp[1]    |
| P4.4     |              |                  |                      | scb[4].uart_rx    |                    | scb[4].spi_mosi   |
| P4.5     |              |                  |                      | scb[4].uart_tx    |                    | scb[4].spi_miso   |
| P4.6     |              |                  |                      | scb[4].uart_cts   |                    | scb[4].spi_clk    |
| P4.7     |              |                  |                      | scb[4].uart_rts   |                    | scb[4].spi_select |

**Table 4** Pin assignments *(continued)*

| Port/Pin | Analog | Smart I/O | ACT #0               | ACT #1           | ACT #3 | DS #2            |
|----------|--------|-----------|----------------------|------------------|--------|------------------|
| P5.6     |        |           | tcpwm.line[7]:0      |                  |        | scb[4].spi_selec |
| P5.7     |        |           | tcpwm.line_comp[7]:0 |                  |        | scb[4].spi_selec |
| P7.0     |        |           | tcpwm.line[0]:2      | scb[3].uart_rx:2 |        | scb[3].i2c_scl:2 |
| P7.1     |        |           | tcpwm.line_comp[0]:2 | scb[3].uart_tx:2 |        | scb[3].i2c_sda:2 |

### 3 Power

The following power system diagram shows the set of power supply pins as implemented for the PSoC™ 4100S Plus. The system has one regulator in Active mode for the digital circuitry. There is no analog regulator; the analog circuits run directly from the VDDA input.



**Figure 4 Power supply connections**

There are two distinct modes of operation. In Mode 1, the supply voltage range is 1.8 V to 5.5 V (unregulated externally; internal regulator operational). In Mode 2, the supply range is 1.8 V  $\pm$  5% (externally regulated; 1.71 V to 1.89 V, internal regulator bypassed).

#### 3.1 Mode 1: 1.8 V to 5.5 V external supply

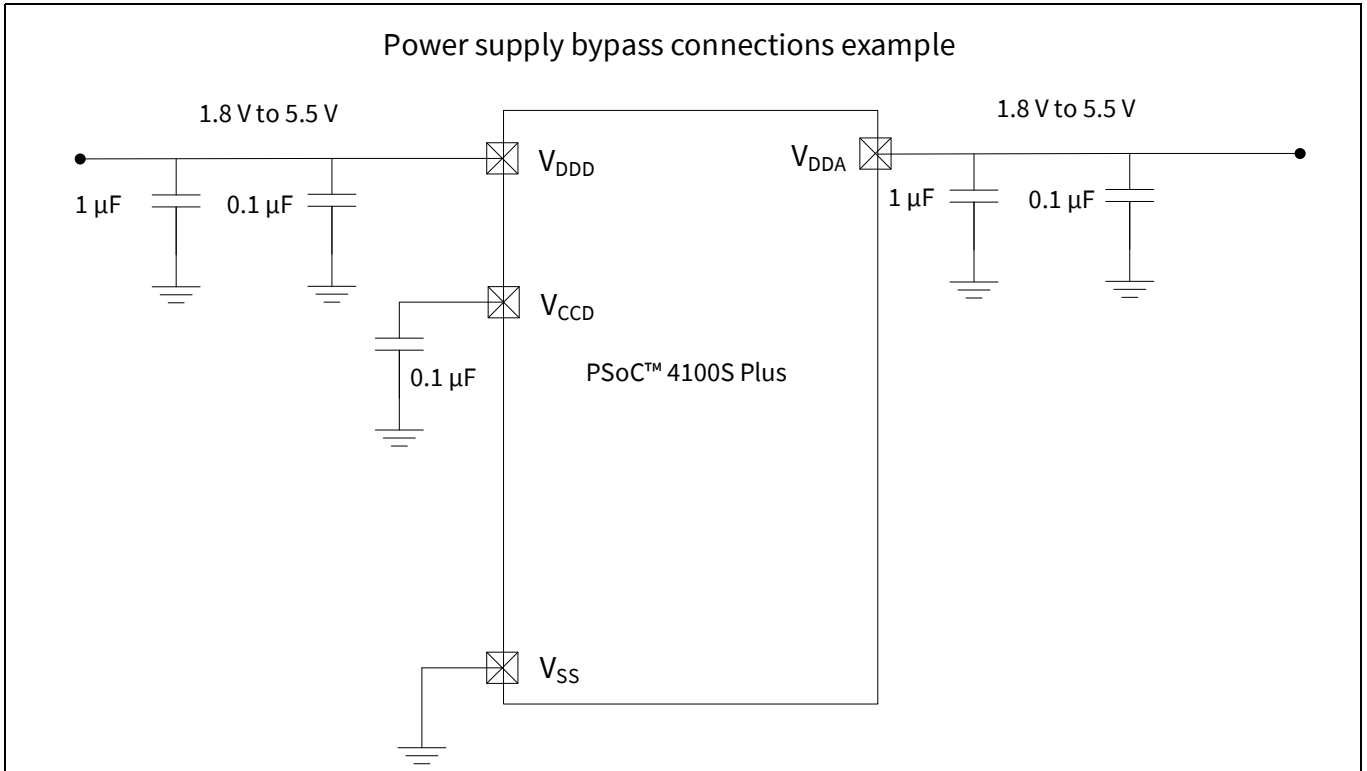
In this mode, PSoC™ 4100S Plus is powered by an external power supply that can be anywhere in the range of 1.8 V to 5.5 V. This range is also designed for battery-powered operation. For example, the chip can be powered from a battery system that starts at 3.5 V and works down to 1.8 V. In this mode, the internal regulator of PSoC™ 4100S Plus supplies the internal logic and its output is connected to the VCCD pin. The VCCD pin must be bypassed to ground via an external capacitor (0.1  $\mu$ F; X5R ceramic or better) and must not be connected to anything else.

#### 3.2 Mode 2: 1.8 V $\pm$ 5% external supply

In this mode, PSoC™ 4100S Plus is powered by an external power supply that must be within the range of 1.71 V to 1.89 V; note that this range needs to include the power supply ripple too. In this mode, the VDD and VCCD pins are shorted together and bypassed.

Bypass capacitors must be used from VDDD to ground. The typical practice for systems in this frequency range is to use a capacitor in the 1- $\mu$ F range, in parallel with a smaller capacitor (0.1  $\mu$ F, for example). Note that these are simply rules of thumb and that, for critical applications, the PCB layout, lead inductance, and the bypass capacitor parasitic should be simulated to design and obtain optimal bypassing. On some packages, VDDD and VDDA pins are shorted inside the package and brought out as a generic VDD pin. In that case, only 0.1- $\mu$ F and 1- $\mu$ F decoupling capacitors are required on the VDD pin.

An example of a bypass scheme is shown in the following diagram.



**Figure 5 External supply range from 1.8 V to 5.5 V with internal regulator active**

Electrical specifications

## 4 Electrical specifications

### 4.1 Absolute maximum ratings

**Table 5** Absolute maximum ratings<sup>[1]</sup>

| Spec ID# | Parameter                         | Description  | Min  | Typ | Max                   | Unit | Details/<br>conditions      |
|----------|-----------------------------------|--|------|-----|-----------------------|------|-----------------------------|
| SID1     | V <sub>DDD_ABS</sub>              | Digital supply relative to V <sub>SS</sub>   | -0.5 | -   | 6                     | V    | -                           |
| SID2     | V <sub>CCD_ABS</sub>              | Direct digital core voltage input relative to V <sub>SS</sub>  | -0.5 | -   | 1.95                  |      | -                           |
| SID3     | V <sub>GPI0_ABS</sub>             | GPIO voltage   | -0.5 | -   | V <sub>DD</sub> + 0.5 |      | -                           |
| SID4     | I <sub>GPI0_ABS</sub>             | Maximum current per GPIO   | -25  | -   | 25                    | mA   | -                           |
| SID5     | I <sub>GPI0_in-<br/>jection</sub> | GPIO injection current,<br>Max for V <sub>IH</sub> > V <sub>DDD</sub> , and<br>Min for V <sub>IL</sub> < V <sub>SS</sub> | -0.5 | -   | 0.5                   |      | Current injected<br>per pin |
| BID44    | ESD_HBM                           | Electrostatic discharge<br>human body model  | 2200 | -   | -                     | V    | -                           |
| BID45    | ESD_CDM                           | Electrostatic discharge<br>charged device model  | 500  | -   | -                     |      | -                           |
| BID46    | LU                                | Pin current for latch-up   | -140 | -   | 140                   | mA   | -                           |

**Note**

- Usage above the absolute maximum conditions listed in **Table 5** may cause permanent damage to the device. Exposure to Absolute Maximum conditions for extended periods of time may affect device reliability. The Maximum Storage Temperature is 150°C in compliance with JEDEC Standard JESD22-A103, High Temperature Storage Life. When used below Absolute Maximum conditions but above normal operating conditions, the device may not operate to specification.

Electrical specifications

## 4.2 Device-level specifications

All specifications are valid for  $-40^{\circ}\text{C} \leq \text{TA} \leq 85^{\circ}\text{C}$  for Grade-A devices,  $-40^{\circ}\text{C} \leq \text{TA} \leq 105^{\circ}\text{C}$  for Grade-S devices, and  $-40^{\circ}\text{C} \leq \text{TA} \leq 125^{\circ}\text{C}$  for Grade-E devices. Specifications are valid for 1.71 V to 5.5 V, except where noted.

**Table 6 DC specifications**

Typical values measured at  $V_{\text{DD}} = 3.3\text{ V}$  and  $25^{\circ}\text{C}$ .

| Spec ID#  | Parameter           | Description   | Min  | Typ | Max  | Unit          | Details/conditions  |
|---|---------------------|---|------|-----|------|---------------|---|
| SID53   | $V_{\text{DD}}$     | Power supply input voltage  | 1.8  | –   | 5.5  | V             | Internally regulated supply                                   |
| SID255  | $V_{\text{DD}}$     | Power supply input voltage ( $V_{\text{CCD}} = V_{\text{DDD}} = V_{\text{DDA}}$ ) | 1.71 | –   | 1.89 |               | Internally unregulated supply                                 |
| SID54   | $V_{\text{CCD}}$    | Output voltage (for core logic)   | –    | 1.8 | –    |               | –   |
| SID55   | $C_{\text{EFC}}$    | External regulator voltage bypass   | –    | 0.1 | –    | $\mu\text{F}$ | X5R ceramic or better   |
| SID56   | $C_{\text{EXC}}$    | Power supply bypass capacitor   | –    | 1   | –    |               | X5R ceramic or better   |
| <b>Active mode, <math>V_{\text{DD}} = 1.8\text{ V}</math> to <math>5.5\text{ V}</math>. Typical values measured at <math>V_{\text{DD}} = 3.3\text{ V}</math> and <math>25^{\circ}\text{C}</math>.</b> |                     |   |      |     |      |               |   |
| SID10   | $I_{\text{DD5}}$    | Execute from flash; CPU at 6 MHz  | –    | 1.8 | 2.7  | mA            | Max is at $125^{\circ}\text{C}$ and $5.5\text{ V}$            |
| SID16   | $I_{\text{DD8}}$    | Execute from flash; CPU at 24 MHz   | –    | 3.0 | 5    |               | Max is at $125^{\circ}\text{C}$ and $5.5\text{ V}$            |
| SID19   | $I_{\text{DD11}}$   | Execute from flash; CPU at 48 MHz   | –    | 5.4 | 7.6  |               | Max is at $125^{\circ}\text{C}$ and $5.5\text{ V}$            |
| <b>Sleep mode, <math>V_{\text{DDD}} = 1.8\text{ V}</math> to <math>5.5\text{ V}</math> (Regulator on)</b>   |                     |   |      |     |      |               |   |
| SID22   | $I_{\text{DD17}}$   | $I^2\text{C}$ wakeup WDT, and Comparators on                                      | –    | 1.1 | 2.2  | mA            | 6 MHz. Max is at $125^{\circ}\text{C}$ and $5.5\text{ V}$ .   |
| SID25   | $I_{\text{DD20}}$   | $I^2\text{C}$ wakeup, WDT, and Comparators on                                     | –    | 1.5 | 2.5  |               | 12 MHz. Max is at $125^{\circ}\text{C}$ and $5.5\text{ V}$ .  |
| <b>Sleep mode, <math>V_{\text{DDD}} = 1.71\text{ V}</math> to <math>1.89\text{ V}</math> (Regulator bypassed)</b>   |                     |   |      |     |      |               |   |
| SID28   | $I_{\text{DD23}}$   | $I^2\text{C}$ wakeup, WDT, and Comparators on                                     | –    | 1.1 | 1.8  | mA            | 6 MHz. Max is at $125^{\circ}\text{C}$ and $1.89\text{ V}$ .  |
| SID28A  | $I_{\text{DD23A}}$  | $I^2\text{C}$ wakeup, WDT, and Comparators on                                     | –    | 1.5 | 2.1  |               | 12 MHz. Max is at $125^{\circ}\text{C}$ and $1.89\text{ V}$ . |
| <b>Deep Sleep mode, <math>V_{\text{DD}} = 1.8\text{ V}</math> to <math>3.6\text{ V}</math> (Regulator on)</b>   |                     |   |      |     |      |               |   |
| SID30   | $I_{\text{DD25}}$   | $I^2\text{C}$ wakeup and WDT on   | –    | 2.5 | 40   | $\mu\text{A}$ | $T = -40^{\circ}\text{C}$ to $60^{\circ}\text{C}$             |
| SID31   | $I_{\text{DD26}}$   | $I^2\text{C}$ wakeup and WDT on   | –    | 2.5 | 350  |               | Max is at $3.6\text{ V}$ and $125^{\circ}\text{C}$            |
| <b>Deep Sleep mode, <math>V_{\text{DD}} = 3.6\text{ V}</math> to <math>5.5\text{ V}</math> (Regulator on)</b>   |                     |   |      |     |      |               |   |
| SID33   | $I_{\text{DD28}}$   | $I^2\text{C}$ wakeup and WDT on   | –    | 2.5 | 40   | $\mu\text{A}$ | $T = -40^{\circ}\text{C}$ to $60^{\circ}\text{C}$             |
| SID34   | $I_{\text{DD29}}$   | $I^2\text{C}$ wakeup and WDT on   | –    | 2.5 | 350  |               | Max is at $5.5\text{ V}$ and $125^{\circ}\text{C}$            |
| <b>Deep Sleep mode, <math>V_{\text{DD}} = V_{\text{CCD}} = 1.71\text{ V}</math> to <math>1.89\text{ V}</math> (Regulator bypassed)</b>  |                     |   |      |     |      |               |   |
| SID36   | $I_{\text{DD31}}$   | $I^2\text{C}$ wakeup and WDT on   | –    | 2.5 | 60   | $\mu\text{A}$ | $T = -40^{\circ}\text{C}$ to $60^{\circ}\text{C}$             |
| SID37   | $I_{\text{DD32}}$   | $I^2\text{C}$ wakeup and WDT on   | –    | 2.5 | 400  |               | Max is at $125^{\circ}\text{C}$ and $1.89\text{ V}$           |
| <b>XRES current</b>   |                     |   |      |     |      |               |   |
| SID307  | $I_{\text{DD\_XR}}$ | Supply current while XRES asserted  | –    | 2   | 5    | mA            | –   |

Electrical specifications

**Table 7 AC specifications**

| Spec ID# | Parameter              | Description                 | Min | Typ | Max | Unit | Details/conditions           |
|----------|------------------------|-----------------------------|-----|-----|-----|------|------------------------------|
| SID48    | F <sub>CPU</sub>       | CPU frequency               | DC  | –   | 48  | MHz  | 1.71 ≤ V <sub>DD</sub> ≤ 5.5 |
| SID49    | T <sub>SLEEP</sub>     | Wakeup from Sleep mode      | –   | 0   | –   | μs   | –                            |
| SID50    | T <sub>DEEPSLEEP</sub> | Wakeup from Deep Sleep mode | –   | 35  | –   |      | –                            |

**4.2.1 GPIO**

**Table 8 GPIO DC specifications**

| Spec ID#              | Parameter                      | Description  | Min                     | Typ | Max                    | Unit  | Details/conditions                                  |
|-----------------------|--------------------------------|--|-------------------------|-----|------------------------|---|---|
| SID57                 | V <sub>IH</sub> <sup>[2]</sup> | Input voltage high threshold   | 0.7 × V <sub>DDD</sub>  | –   | –                      | V   | CMOS Input  |
| SID58                 | V <sub>IL</sub>                | Input voltage low threshold  | –                       | –   | 0.3 × V <sub>DDD</sub> |   | CMOS Input  |
| SID241                | V <sub>IH</sub> <sup>[2]</sup> | LVTTL input, V <sub>DDD</sub> < 2.7 V                                | 0.7 × V <sub>DDD</sub>  | –   | –                      |   | –   |
| SID242                | V <sub>IL</sub>                | LVTTL input, V <sub>DDD</sub> < 2.7 V                                | –                       | –   | 0.3 × V <sub>DDD</sub> |   | –   |
| SID243                | V <sub>IH</sub> <sup>[2]</sup> | LVTTL input, V <sub>DDD</sub> ≥ 2.7 V                                | 2.0                     | –   | –                      |   | –   |
| SID244                | V <sub>IL</sub>                | LVTTL input, V <sub>DDD</sub> ≥ 2.7 V                                | –                       | –   | 0.8                    |   | –   |
| SID59                 | V <sub>OH</sub>                | Output voltage high level  | V <sub>DDD</sub> – 0.6  | –   | –                      |   | I <sub>OH</sub> = 4 mA at 3 V<br>V <sub>DDD</sub>   |
| SID60                 | V <sub>OH</sub>                | Output voltage high level  | V <sub>DDD</sub> – 0.5  | –   | –                      |   | I <sub>OH</sub> = 1 mA at 1.8 V<br>V <sub>DDD</sub> |
| SID61                 | V <sub>OL</sub>                | Output voltage low level   | –                       | –   | 0.6                    |   | I <sub>OL</sub> = 4 mA at 1.8 V<br>V <sub>DDD</sub> |
| SID62                 | V <sub>OL</sub>                | Output voltage low level   | –                       | –   | 0.6                    |   | I <sub>OL</sub> = 10 mA at 3 V<br>V <sub>DDD</sub>  |
| SID62A                | V <sub>OL</sub>                | Output voltage low level   | –                       | –   | 0.4                    | I <sub>OL</sub> = 3 mA at 3 V<br>V <sub>DDD</sub> |   |
| SID63                 | R <sub>PULLUP</sub>            | Pull-up resistor   | 3.5                     | 5.6 | 8.5                    | kΩ  | –   |
| SID64                 | R <sub>PULLDOWN</sub>          | Pull-down resistor   | 3.5                     | 5.6 | 8.5                    |   | –   |
| SID65                 | I <sub>IL</sub>                | Input leakage current (absolute value)                               | –                       | –   | 2                      | nA  | 25°C, V <sub>DDD</sub> = 3.0 V                      |
| SID66                 | C <sub>IN</sub>                | Input capacitance  | –                       | –   | 7                      | pF  | –   |
| SID67 <sup>[3]</sup>  | V <sub>HYSTTTL</sub>           | Input hysteresis LVTTL   | 25                      | 40  | –                      | mV  | V <sub>DDD</sub> ≥ 2.7 V                            |
| SID68 <sup>[3]</sup>  | V <sub>HYS CMOS</sub>          | Input hysteresis CMOS  | 0.05 × V <sub>DDD</sub> | –   | –                      |   | V <sub>DD</sub> < 4.5 V                             |
| SID68A <sup>[3]</sup> | V <sub>HYS CMOS5V5</sub>       | Input hysteresis CMOS  | 200                     | –   | –                      |   | V <sub>DD</sub> > 4.5 V                             |
| SID69 <sup>[3]</sup>  | I <sub>DIODE</sub>             | Current through protection diode to V <sub>DD</sub> /V <sub>SS</sub> | –                       | –   | 100                    | μA  | –   |
| SID69A <sup>[3]</sup> | I <sub>TOT_GPIO</sub>          | Maximum total source or sink chip current                            | –                       | –   | 200                    | mA  | –   |

**Notes**

2. V<sub>IH</sub> must not exceed V<sub>DDD</sub> + 0.2 V.
3. Guaranteed by characterization.

Electrical specifications

**Table 9 GPIO AC specifications**

(Guaranteed by characterization)

| Spec ID# | Parameter            | Description   | Min | Typ | Max  | Unit | Details/conditions                         |
|----------|----------------------|---|-----|-----|------|------|--|
| SID70    | T <sub>RISEF</sub>   | Rise time in fast strong mode   | 2   | –   | 12   | ns   | 3.3 V V <sub>DDD</sub> ,<br>Clload = 25 pF |
| SID71    | T <sub>FALLF</sub>   | Fall time in fast strong mode   | 2   | –   | 12   |      | 3.3 V V <sub>DDD</sub> ,<br>Clload = 25 pF |
| SID72    | T <sub>RISES</sub>   | Rise time in slow strong mode   | 10  | –   | 60   | –    | 3.3 V V <sub>DDD</sub> ,<br>Clload = 25 pF |
| SID73    | T <sub>FALLS</sub>   | Fall time in slow strong mode   | 10  | –   | 60   | –    | 3.3 V V <sub>DDD</sub> ,<br>Clload = 25 pF |
| SID74    | F <sub>GPIOUT1</sub> | GPIO F <sub>OUT</sub> ;<br>3.3 V ≤ V <sub>DDD</sub> ≤ 5.5 V<br>Fast strong mode   | –   | –   | 33   | MHz  | 90/10%, 25 pF load,<br>60/40 duty cycle    |
| SID75    | F <sub>GPIOUT2</sub> | GPIO F <sub>OUT</sub> ;<br>1.71 V ≤ V <sub>DDD</sub> ≤ 3.3 V<br>Fast strong mode  | –   | –   | 16.7 |      | 90/10%, 25 pF load,<br>60/40 duty cycle    |
| SID76    | F <sub>GPIOUT3</sub> | GPIO F <sub>OUT</sub> ;<br>3.3 V ≤ V <sub>DDD</sub> ≤ 5.5 V<br>Slow strong mode   | –   | –   | 7    |      | 90/10%, 25 pF load,<br>60/40 duty cycle    |
| SID245   | F <sub>GPIOUT4</sub> | GPIO F <sub>OUT</sub> ;<br>1.71 V ≤ V <sub>DDD</sub> ≤ 3.3 V<br>Slow strong mode. | –   | –   | 3.5  |      | 90/10%, 25 pF load,<br>60/40 duty cycle    |
| SID246   | F <sub>GPIOIN</sub>  | GPIO input operating<br>frequency;<br>1.71 V ≤ V <sub>DDD</sub> ≤ 5.5 V           | –   | –   | 48   |      | 90/10% V <sub>IO</sub>                     |

## 4.2.2 XRES

**Table 10 XRES DC specifications**

| Spec ID#             | Parameter     | Description   | Min                  | Typ | Max                  | Unit       | Details/conditions                                |
|----------------------|---------------|---|----------------------|-----|----------------------|------------|---|
| SID77                | $V_{IH}$      | Input voltage high threshold                        | $0.7 \times V_{DDD}$ | –   | –                    | V          | CMOS Input  |
| SID78                | $V_{IL}$      | Input voltage low threshold                         | –                    | –   | $0.3 \times V_{DDD}$ |            |   |
| SID79                | $R_{PULLUP}$  | Pull-up resistor                                    | –                    | 60  | –                    | k $\Omega$ | –   |
| SID80                | $C_{IN}$      | Input capacitance                                   | –                    | –   | 7                    | pF         | –   |
| SID81 <sup>[4]</sup> | $V_{HYSXRES}$ | Input voltage hysteresis                            | –                    | 100 | –                    | mV         | Typical hysteresis is 200 mV for $V_{DD} > 4.5$ V |
| SID82                | $I_{DIODE}$   | Current through protection diode to $V_{DD}/V_{SS}$ | –                    | –   | 100                  | $\mu$ A    | –   |

**Table 11 XRES AC specifications**

| Spec ID#              | Parameter        | Description                     | Min | Typ | Max | Unit    | Details/conditions |
|-----------------------|------------------|---------------------------------|-----|-----|-----|---------|--------------------|
| SID83 <sup>[4]</sup>  | $T_{RESETWIDTH}$ | Reset pulse width               | 1   | –   | –   | $\mu$ s | –                  |
| BID194 <sup>[4]</sup> | $T_{RESETWAKE}$  | Wake-up time from reset release | –   | –   | 2.7 | ms      | –                  |

**Note**

4. Guaranteed by characterization.

Electrical specifications

## 4.3 Analog peripherals

### 4.3.1 CTBm opamp

**Table 12 CTBm opamp specifications**

| Spec ID# | Parameter           | Description                               | Min | Typ  | Max  | Units | Details/conditions                              |
|----------|---------------------|---|-----|------|------|-------|---|
|          | $I_{DD}$            | Opamp block current,<br>External load     |     |      |      |       |   |
| SID269   | $I_{DD\_HI}$        | power = hi                                | –   | 1100 | 1850 | μA    | –   |
| SID270   | $I_{DD\_MED}$       | power = med                               | –   | 550  | 950  |       | –   |
| SID271   | $I_{DD\_LOW}$       | power = lo                                | –   | 150  | 350  |       | –   |
|          | $G_{BW}$            | Load = 20 pF, 0.1 mA<br>$V_{DDA} = 2.7 V$ |     |      |      |       |   |
| SID272   | $G_{BW\_HI}$        | power = hi                                | 6   | –    | –    | MHz   | Input and output are 0.2 V to $V_{DDA} - 0.2 V$ |
| SID273   | $G_{BW\_MED}$       | power = med                               | 3   | –    | –    |       | Input and output are 0.2 V to $V_{DDA} - 0.2 V$ |
| SID274   | $G_{BW\_LO}$        | power = lo                                | –   | 1    | –    |       | Input and output are 0.2 V to $V_{DDA} - 0.2 V$ |
|          | $I_{OUT\_MAX}$      | $V_{DDA} = 2.7 V$ , 500 mV<br>from rail   |     |      |      |       |   |
| SID275   | $I_{OUT\_MAX\_HI}$  | power = hi                                | 10  | –    | –    | mA    | Output is 0.5 V to $V_{DDA} - 0.5 V$            |
| SID276   | $I_{OUT\_MAX\_MID}$ | power = mid                               | 10  | –    | –    |       | Output is 0.5 V to $V_{DDA} - 0.5 V$            |
| SID277   | $I_{OUT\_MAX\_LO}$  | power = lo                                | –   | 5    | –    |       | Output is 0.5 V to $V_{DDA} - 0.5 V$            |
|          | $I_{OUT}$           | $V_{DDA} = 1.71 V$ , 500 mV<br>from rail  |     |      |      |       |   |
| SID278   | $I_{OUT\_MAX\_HI}$  | power = hi                                | 4   | –    | –    | mA    | Output is 0.5 V to $V_{DDA} - 0.5 V$            |
| SID279   | $I_{OUT\_MAX\_MID}$ | power = mid                               | 4   | –    | –    |       | Output is 0.5 V to $V_{DDA} - 0.5 V$            |
| SID280   | $I_{OUT\_MAX\_LO}$  | power = lo                                | –   | 2    | –    |       | Output is 0.5 V to $V_{DDA} - 0.5 V$            |
|          | $I_{DD\_Int}$       | Opamp block current<br>Internal Load      |     |      |      |       |   |
| SID269_I | $I_{DD\_HI\_Int}$   | power = hi                                | –   | 1500 | 1700 | μA    | –   |
| SID270_I | $I_{DD\_MED\_Int}$  | power = med                               | –   | 700  | 900  |       | –   |
| SID271_I | $I_{DD\_LOW\_Int}$  | power = lo                                | –   | –    | –    |       | –   |
|          | $G_{BW}$            | $V_{DDA} = 2.7 V$                         | –   | –    | –    |       |   |
| SID272_I | $G_{BW\_HI\_Int}$   | power = hi                                | 8   | –    | –    | MHz   | Output is 0.25 V to $V_{DDA} - 0.25 V$          |

Electrical specifications

**Table 12** CTBm opamp specifications (continued)

| Spec ID# | Parameter        | Description  | Min   | Typ       | Max             | Units                        | Details/conditions   |
|----------|------------------|--|-------|-----------|-----------------|------------------------------|--|
|          |                  | General opamp specs for both internal and external modes |       |           |                 |                              |  |
| SID281   | $V_{IN}$         | Charge-pump on, $V_{DDA} = 2.7\text{ V}$                 | -0.05 | -         | $V_{DDA} - 0.2$ | V                            | -  |
| SID282   | $V_{CM}$         | Charge-pump on, $V_{DDA} = 2.7\text{ V}$                 | -0.05 | -         | $V_{DDA} - 0.2$ |                              | -  |
|          | $V_{OUT}$        | $V_{DDA} = 2.7\text{ V}$                                 |       |           |                 |                              |  |
| SID283   | $V_{OUT\_1}$     | power = hi, $I_{load} = 10\text{ mA}$                    | 0.5   | -         | $V_{DDA} - 0.5$ | V                            | -  |
| SID284   | $V_{OUT\_2}$     | power = hi, $I_{load} = 1\text{ mA}$                     | 0.2   | -         | $V_{DDA} - 0.2$ |                              | -  |
| SID285   | $V_{OUT\_3}$     | power = med, $I_{load} = 1\text{ mA}$                    | 0.2   | -         | $V_{DDA} - 0.2$ |                              | -  |
| SID286   | $V_{OUT\_4}$     | power = lo, $I_{load} = 0.1\text{ mA}$                   | 0.2   | -         | $V_{DDA} - 0.2$ |                              | -  |
| SID288   | $V_{OS\_TR}$     | Offset voltage, trimmed                                  | -1.0  | $\pm 0.5$ | 1.0             | mV                           | High mode, input 0 V to $V_{DDA} - 0.2\text{ V}$                                       |
| SID288A  | $V_{OS\_TR}$     | Offset voltage, trimmed                                  | -     | $\pm 1.4$ | -               |                              | Medium mode, input 0 V to $V_{DDA} - 0.2\text{ V}$                                     |
| SID288B  | $V_{OS\_TR}$     | Offset voltage, trimmed                                  | -     | $\pm 2$   | -               |                              | Low mode, input 0 V to $V_{DDA} - 0.2\text{ V}$  |
| SID290   | $V_{OS\_DR\_TR}$ | Offset voltage drift, trimmed                            | -10   | $\pm 3$   | 10              | $\mu\text{V}/^\circ\text{C}$ | High mode  |
| SID290A  | $V_{OS\_DR\_TR}$ | Offset voltage drift, trimmed                            | -     | $\pm 10$  | -               | $\mu\text{V}/^\circ\text{C}$ | Medium mode  |
| SID290B  | $V_{OS\_DR\_TR}$ | Offset voltage drift, trimmed                            | -     | $\pm 10$  | -               |                              | Low mode   |
| SID291   | CMRR             | DC   | 70    | 80        | -               | dB                           | Input is 0 V to $V_{DDA} - 0.2\text{ V}$ , Output is 0.2 V to $V_{DDA} - 0.2\text{ V}$ |
| SID292   | PSRR             | At 1 kHz, 10-mV ripple                                   | 70    | 85        | -               |                              | $V_{DDD} = 3.6\text{ V}$ , high-power mode, input is 0.2 V to $V_{DDA} - 0.2\text{ V}$ |
|          | Noise            |  |       |           |                 |                              |  |
| SID294   | VN2              | Input-referred, 1 kHz, power = Hi                        | -     | 72        | -               | nV/<br>rtHz                  | 3  |
| SID295   | VN3              | Input-referred, 10 kHz, power = Hi                       | -     | 28        | -               |                              | Input and output are at 0.2 V to $V_{DDA} - 0.2\text{ V}$                              |
| SID296   | VN4              | Input-referred, 100 kHz, power = Hi                      | -     | 15        | -               |                              | Input and output are at 0.2 V to $V_{DDA} - 0.2\text{ V}$                              |

Electrical specifications

**Table 12** CTBm opamp specifications (continued)

| Spec ID# | Parameter              | Description   | Min | Typ  | Max | Units | Details/conditions                         |
|----------|------------------------|---|-----|------|-----|-------|--|
| SID297   | C <sub>LOAD</sub>      | Stable up to max. load. Performance specs at 50 pF.                           | –   | –    | 125 | pF    | –  |
| SID298   | SLEW_RATE              | Clod = 50 pF, Power = High, V <sub>DDA</sub> = 2.7 V                          | 6   | –    | –   | V/μs  | –  |
| SID299   | T <sub>OP_WAKE</sub>   | From disable to enable, no external RC dominating                             | –   | –    | 25  | μs    | –  |
| SID299A  | OL_GAIN                | Open Loop Gain  | –   | 90   | –   | dB    | –  |
|          | COMP_MODE              | Comparator mode; 50 mV drive, T <sub>rise</sub> = T <sub>fall</sub> (approx.) |     |      |     |       |  |
| SID300   | TPD1                   | Response time; power = hi   | –   | 150  | –   | ns    | Input is 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID301   | TPD2                   | Response time; power = med  | –   | 500  | –   |       | Input is 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID302   | TPD3                   | Response time; power = lo   | –   | 2500 | –   |       | Input is 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID303   | VHYST_OP               | Hysteresis  | –   | 10   | –   | mV    | –  |
| SID304   | WUP_CTB                | Wake-up time from Enabled to Usable   | –   | –    | 25  | μs    | –  |
|          | Deep Sleep Mode        | Mode 2 is lowest current range. Mode 1 has higher GBW.                        |     |      |     |       |  |
| SID_DS_1 | I <sub>DD_HI_M1</sub>  | Mode 1, High current  | –   | 1400 | –   | μA    | 25°C                                       |
| SID_DS_2 | I <sub>DD_MED_M1</sub> | Mode 1, Medium current  | –   | 700  | –   |       | 25°C                                       |
| SID_DS_3 | I <sub>DD_LOW_M1</sub> | Mode 1, Low current   | –   | 200  | –   |       | 25°C                                       |
| SID_DS_4 | I <sub>DD_HI_M2</sub>  | Mode 2, High current  | –   | 120  | –   |       | 25°C                                       |
| SID_DS_5 | I <sub>DD_MED_M2</sub> | Mode 2, Medium current  | –   | 60   | –   |       | 25°C                                       |
| SID_DS_6 | I <sub>DD_LOW_M2</sub> | Mode 2, Low current   | –   | 15   | –   |       | 25°C                                       |

Electrical specifications

**Table 12** CTBm opamp specifications (continued)

| Spec ID#  | Parameter               | Description            | Min | Typ | Max | Units | Details/conditions                                       |
|-----------|-------------------------|------------------------|-----|-----|-----|-------|--|
| SID_DS_7  | G <sub>BW_HI_M1</sub>   | Mode 1, High current   | –   | 4   | –   | MHz   | 20-pF load, no DC load 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID_DS_8  | G <sub>BW_MED_M1</sub>  | Mode 1, Medium current | –   | 2   | –   |       | 20-pF load, no DC load 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID_DS_9  | G <sub>BW_LOW_M1</sub>  | Mode 1, Low current    | –   | 0.5 | –   |       | 20-pF load, no DC load 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID_DS_10 | G <sub>BW_HI_M2</sub>   | Mode 2, High current   | –   | 0.5 | –   |       | 20-pF load, no DC load 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID_DS_11 | G <sub>BW_MED_M2</sub>  | Mode 2, Medium current | –   | 0.2 | –   |       | 20-pF load, no DC load 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID_DS_12 | G <sub>BW_LOW_M2</sub>  | Mode 2, Low current    | –   | 0.1 | –   |       | 20-pF load, no DC load 0.2 V to V <sub>DDA</sub> – 0.2 V |
| SID_DS_13 | V <sub>OS_HI_M1</sub>   | Mode 1, High current   | –   | 5   | –   | mV    | With trim 25°C, 0.2 V to V <sub>DDA</sub> – 0.2 V        |
| SID_DS_14 | V <sub>OS_MED_M1</sub>  | Mode 1, Medium current | –   | 5   | –   |       | With trim 25°C, 0.2 V to V <sub>DDA</sub> – 0.2 V        |
| SID_DS_15 | V <sub>OS_LOW_M2</sub>  | Mode 1, Low current    | –   | 5   | –   |       | With trim 25°C, 0.2 V to V <sub>DDA</sub> – 0.2 V        |
| SID_DS_16 | V <sub>OS_HI_M2</sub>   | Mode 2, High current   | –   | 5   | –   |       | With trim 25°C, 0.2 V to V <sub>DDA</sub> – 0.2 V        |
| SID_DS_17 | V <sub>OS_MED_M2</sub>  | Mode 2, Medium current | –   | 5   | –   |       | With trim 25°C, 0.2 V to V <sub>DDA</sub> – 0.2 V        |
| SID_DS_18 | V <sub>OS_LOW_M2</sub>  | Mode 2, Low current    | –   | 5   | –   |       | With trim 25°C, 0.2 V to V <sub>DDA</sub> – 0.2 V        |
| SID_DS_19 | I <sub>OUT_HI_M1</sub>  | Mode 1, High current   | –   | 10  | –   | mA    | Output is 0.5 V to V <sub>DDA</sub> – 0.5 V              |
| SID_DS_20 | I <sub>OUT_MED_M1</sub> | Mode 1, Medium current | –   | 10  | –   |       | Output is 0.5 V to V <sub>DDA</sub> – 0.5 V              |
| SID_DS_21 | I <sub>OUT_LOW_M1</sub> | Mode 1, Low current    | –   | 4   | –   |       | Output is 0.5 V to V <sub>DDA</sub> – 0.5 V              |
| SID_DS_22 | I <sub>OUT_HI_M2</sub>  | Mode 2, High current   | –   | 1   | –   |       | –  |
| SID_DS_23 | I <sub>OU_MED_M2</sub>  | Mode 2, Medium current | –   | 1   | –   |       | –  |
| SID_DS_24 | I <sub>OU_LOW_M2</sub>  | Mode 2, Low current    | –   | 0.5 | –   |       | –  |

Electrical specifications

### 4.3.2 Comparator

**Table 13 Comparator DC specifications**

| Spec ID# | Parameter            | Description                                       | Min | Typ | Max                     | Units | Details/conditions                |
|----------|----------------------|---|-----|-----|-------------------------|-------|-----------------------------------|
| SID84    | V <sub>OFFSET1</sub> | Input offset voltage, Factory trim                | –   | –   | ±10                     | mV    | –                                 |
| SID85    | V <sub>OFFSET2</sub> | Input offset voltage, Custom trim                 | –   | –   | ±4                      |       | –                                 |
| SID86    | V <sub>HYST</sub>    | Hysteresis when enabled                           | –   | 10  | 35                      |       | –                                 |
| SID87    | V <sub>ICM1</sub>    | Input common mode voltage in normal mode          | 0   | –   | V <sub>DDD</sub> – 0.1  | V     | Modes 1 and 2                     |
| SID247   | V <sub>ICM2</sub>    | Input common mode voltage in low power mode       | 0   | –   | V <sub>DDD</sub>        |       | –                                 |
| SID247A  | V <sub>ICM3</sub>    | Input common mode voltage in ultra low power mode | 0   | –   | V <sub>DDD</sub> – 1.15 |       | V <sub>DDD</sub> ≥ 2.2 V at –40°C |
| SID88    | C <sub>MRR</sub>     | Common mode rejection ratio                       | 50  | –   | –                       | dB    | V <sub>DDD</sub> ≥ 2.7 V          |
| SID88A   | C <sub>MRR</sub>     | Common mode rejection ratio                       | 42  | –   | –                       |       | V <sub>DDD</sub> ≤ 2.7 V          |
| SID89    | I <sub>CMP1</sub>    | Block current, normal mode                        | –   | –   | 400                     | μA    | –                                 |
| SID248   | I <sub>CMP2</sub>    | Block current, low power mode                     | –   | –   | 100                     |       | –                                 |
| SID259   | I <sub>CMP3</sub>    | Block current in ultra low-power mode             | –   | –   | 6                       |       | V <sub>DDD</sub> ≥ 2.2 V at –40°C |
| SID90    | Z <sub>CMP</sub>     | DC Input impedance of comparator                  | 35  | –   | –                       | MΩ    | –                                 |

**Table 14 Comparator AC specifications**

| Spec ID# | Parameter | Description   | Min | Typ | Max | Unit | Details/conditions                |
|----------|-----------|---|-----|-----|-----|------|-----------------------------------|
| SID91    | TRESP1    | Response time, normal mode, 50 mV overdrive           | –   | 38  | 110 | ns   | –                                 |
| SID258   | TRESP2    | Response time, low power mode, 50 mV overdrive        | –   | 70  | 200 |      | –                                 |
| SID92    | TRESP3    | Response time, ultra-low power mode, 200 mV overdrive | –   | 2.3 | 15  | μs   | V <sub>DDD</sub> ≥ 2.2 V at –40°C |

Electrical specifications

### 4.3.3 Temperature sensor

**Table 15 Temperature sensor specifications**

| Spec ID# | Parameter | Description                 | Min | Typ | Max | Unit | Details/conditions |
|----------|-----------|-----------------------------|-----|-----|-----|------|--------------------|
| SID93    | TSENSACC  | Temperature sensor accuracy | -5  | ±1  | 5   | °C   | -40 to +85°C       |
| SID93A   | TSENSACC  | Temperature sensor accuracy | -15 | ±1  | +15 | °C   | +85 to +150°C      |

### 4.3.4 SAR ADC

**Table 16 SAR ADC specifications**

| Spec ID#                         | Parameter | Description   | Min             | Typ | Max              | Unit | Details/conditions                      |
|----------------------------------|-----------|---|-----------------|-----|------------------|------|---|
| <b>SAR ADC DC specifications</b> |           |   |                 |     |                  |      |   |
| SID94                            | A_RES     | Resolution  | -               | -   | 12               | bits | -                                       |
| SID95                            | A_CHNLS_S | Number of channels - single ended                             | -               | -   | 16               |      | -                                       |
| SID96                            | A-CHNKS_D | Number of channels - differential                             | -               | -   | 4                |      | Diff inputs use neighboring I/O         |
| SID97                            | A-MONO    | Monotonicity  | -               | -   | -                |      | Yes                                     |
| SID98                            | A_GAINERR | Gain error  | -               | -   | ±0.1             | %    | With external reference                 |
| SID99                            | A_OFFSET  | Input offset voltage  | -               | -   | 2                | mV   | Measured with 1 V reference             |
| SID100                           | A_ISAR    | Current consumption   | -               | -   | 1                | mA   | -                                       |
| SID101                           | A_VINS    | Input voltage range - single ended                            | V <sub>SS</sub> | -   | V <sub>DDA</sub> | V    | -                                       |
| SID102                           | A_VIND    | Input voltage range - differential                            | V <sub>SS</sub> | -   | V <sub>DDA</sub> | V    | -                                       |
| SID103                           | A_INRES   | Input resistance  | -               | -   | 2.2              | KΩ   | -                                       |
| SID104                           | A_INCAP   | Input capacitance   | -               | -   | 10               | pF   | -                                       |
| SID260                           | VREFSAR   | Trimmed internal reference to SAR                             | 1.188           | 1.2 | 1.212            | V    | -                                       |
| <b>SAR ADC AC specifications</b> |           |   |                 |     |                  |      |   |
| SID106                           | A_PSRR    | Power supply rejection ratio                                  | 70              | -   | -                | dB   | -                                       |
| SID107                           | A_CMRR    | Common mode rejection ratio                                   | 66              | -   | -                | dB   | Measured at 1 V                         |
| SID108                           | A_SAMP    | Sample rate   | -               | -   | 1                | Msps | -                                       |
| SID109                           | A_SNR     | Signal-to-noise and distortion ratio (SINAD)                  | 65              | -   | -                | dB   | F <sub>IN</sub> = 10 kHz                |
| SID110                           | A_BW      | Input bandwidth without aliasing                              | -               | -   | A_samp/2         | kHz  | -                                       |
| SID111                           | A_INL     | Integral non linearity. V <sub>DD</sub> = 1.71 to 5.5, 1 Msps | -1.7            | -   | 2                | LSB  | V <sub>REF</sub> = 1 to V <sub>DD</sub> |

Electrical specifications

**Table 16 SAR ADC specifications (continued)**

| Spec ID# | Parameter  | Description   | Min  | Typ | Max | Unit | Details/conditions           |
|----------|------------|---|------|-----|-----|------|------------------------------|
| SID111A  | A_INL      | Integral non linearity.<br>$V_{DD} = 1.71$ to $3.6$ ,<br>1 Msps       | -1.5 | -   | 1.7 | LSB  | $V_{REF} = 1.71$ to $V_{DD}$ |
| SID111B  | A_INL      | Integral non linearity.<br>$V_{DD} = 1.71$ to $5.5$ ,<br>500 ksps     | -1.5 | -   | 1.7 | LSB  | $V_{REF} = 1$ to $V_{DD}$    |
| SID112   | A_DNL      | Differential non linearity.<br>$V_{DD} = 1.71$ to $5.5$ , 1 Msps      | -1   | -   | 2.2 | LSB  | $V_{REF} = 1$ to $V_{DD}$    |
| SID112A  | A_DNL      | Differential non linearity.<br>$V_{DD} = 1.71$ to $3.6$ , 1 Msps      | -1   | -   | 2   | LSB  | $V_{REF} = 1.71$ to $V_{DD}$ |
| SID112B  | A_DNL      | Differential non linearity.<br>$V_{DD} = 1.71$ to $5.5$ ,<br>500 ksps | -1   | -   | 2.2 | LSB  | $V_{REF} = 1$ to $V_{DD}$    |
| SID113   | A_THD      | Total harmonic distortion   | -    | -   | -65 | dB   | $F_{in} = 10$ kHz            |
| SID261   | FSARINTREF | SAR operating speed without external reference bypass                 | -    | -   | 100 | ksps | 12-bit resolution            |

### 4.3.5 CSD and IDAC

**Table 17 CSD and IDAC specifications**

| Spec ID#    | Parameter      | Description                                       | Min | Typ | Max             | Unit | Details/conditions  |
|-------------|----------------|---|-----|-----|-----------------|------|---|
| SYS.PER#3   | VDD_RIPPLE     | Max allowed ripple on power supply, DC to 10 MHz  | -   | -   | ±50             | mV   | $V_{DD} > 2$ V (with ripple),<br>$25^{\circ}\text{C}$ $T_A$ ,<br>Sensitivity = 0.1 pF   |
| SYS.PER#16  | VDD_RIPPLE_1.8 | Max allowed ripple on power supply, DC to 10 MHz  | -   | -   | ±25             | mV   | $V_{DD} > 1.75$ V (with ripple), $25^{\circ}\text{C}$ $T_A$ ,<br>Parasitic Capacitance ( $C_p$ ) < 20 pF,<br>Sensitivity ≥ 0.4 pF |
| SID.CSD.BLK | ICSD           | Maximum block current                             | -   | -   | 4000            | μA   | Maximum block current for both IDACs in dynamic (switching) mode including comparators, buffer, and reference generator           |
| SID.CSD#15  | $V_{REF}$      | Voltage reference for CSD and Comparator          | 0.6 | 1.2 | $V_{DDA} - 0.6$ | V    | $V_{DDA} - 0.06$ or 4.4, whichever is lower   |
| SID.CSD#15A | VREF_EXT       | External Voltage reference for CSD and Comparator | 0.6 | -   | $V_{DDA} - 0.6$ | V    | $V_{DDA} - 0.06$ or 4.4, whichever is lower   |

Electrical specifications

**Table 17 CSD and IDAC specifications** (continued)

| Spec ID#   | Parameter  | Description  | Min  | Typ | Max                    | Unit  | Details/conditions   |
|------------|------------|--|------|-----|------------------------|-------|--|
| SID.CSD#16 | IDAC1IDD   | IDAC1 (7-bits) block current                                       | –    | –   | 1750                   | μA    | –  |
| SID.CSD#17 | IDAC2IDD   | IDAC2 (7-bits) block current                                       | –    | –   | 1750                   | μA    | –  |
| SID308     | VCSD       | Voltage range of operation   | 1.71 | –   | 5.5                    | V     | 1.8 V ± 5% or 1.8 V to 5.5 V   |
| SID308A    | VCOMPIDAC  | Voltage compliance range of IDAC                                   | 0.6  | –   | V <sub>DDA</sub> – 0.6 | V     | V <sub>DDA</sub> – 0.06 or 4.4, whichever is lower   |
| SID309     | IDAC1DNL   | DNL  | –1   | –   | 1                      | LSB   | –  |
| SID310     | IDAC1INL   | INL  | –2   | –   | 2                      | LSB   | INL is ±5.5 LSB for V <sub>DDA</sub> < 2 V   |
| SID311     | IDAC2DNL   | DNL  | –1   | –   | 1                      | LSB   | –  |
| SID312     | IDAC2INL   | INL  | –2   | –   | 2                      | LSB   | INL is ±5.5 LSB for V <sub>DDA</sub> < 2 V   |
| SID313     | SNR        | Ratio of counts of finger to noise. Guaranteed by characterization | 5    | –   | –                      | Ratio | Capacitance range of 5 pF to 35 pF, 0.1-pF sensitivity. All use cases. V <sub>DDA</sub> > 2 V. |
| SID314     | IDAC1CRT1  | Output current of IDAC1 (7 bits) in low range                      | 4.2  | –   | 5.4                    | μA    | LSB = 37.5 nA typ  |
| SID314A    | IDAC1CRT2  | Output current of IDAC1 (7 bits) in medium range                   | 34   | –   | 41                     | μA    | LSB = 300 nA typ   |
| SID314B    | IDAC1CRT3  | Output current of IDAC1 (7 bits) in high range                     | 275  | –   | 330                    | μA    | LSB = 2.4 μA typ   |
| SID314C    | IDAC1CRT12 | Output current of IDAC1 (7 bits) in low range, 2X mode             | 8    | –   | 10.5                   | μA    | LSB = 75 nA typ  |
| SID314D    | IDAC1CRT22 | Output current of IDAC1 (7 bits) in medium range, 2X mode          | 69   | –   | 82                     | μA    | LSB = 600 nA typ.  |
| SID314E    | IDAC1CRT32 | Output current of IDAC1 (7 bits) in high range, 2X mode            | 540  | –   | 660                    | μA    | LSB = 4.8 μA typ   |
| SID315     | IDAC2CRT1  | Output current of IDAC2 (7 bits) in low range                      | 4.2  | –   | 5.4                    | μA    | LSB = 37.5 nA typ  |
| SID315A    | IDAC2CRT2  | Output current of IDAC2 (7 bits) in medium range                   | 34   | –   | 41                     | μA    | LSB = 300 nA typ   |
| SID315B    | IDAC2CRT3  | Output current of IDAC2 (7 bits) in high range                     | 275  | –   | 330                    | μA    | LSB = 2.4 μA typ   |

Electrical specifications

**Table 17 CSD and IDAC specifications** (continued)

| Spec ID# | Parameter     | Description   | Min | Typ | Max  | Unit | Details/conditions  |
|----------|---------------|---|-----|-----|------|------|---|
| SID315C  | IDAC2CRT12    | Output current of IDAC2 (7 bits) in low range, 2X mode    | 8   | –   | 10.5 | μA   | LSB = 75 nA typ   |
| SID315D  | IDAC2CRT22    | Output current of IDAC2 (7 bits) in medium range, 2X mode | 69  | –   | 82   | μA   | LSB = 600 nA typ  |
| SID315E  | IDAC2CRT32    | Output current of IDAC2 (7 bits) in high range, 2X mode   | 540 | –   | 660  | μA   | LSB = 4.8 μA typ  |
| SID315F  | IDAC3CRT13    | Output current of IDAC in 8-bit mode in low range         | 8   | –   | 10.5 | μA   | LSB = 37.5 nA typ   |
| SID315G  | IDAC3CRT23    | Output current of IDAC in 8-bit mode in medium range      | 69  | –   | 82   | μA   | LSB = 300 nA typ  |
| SID315H  | IDAC3CRT33    | Output current of IDAC in 8-bit mode in high range        | 540 | –   | 660  | μA   | LSB = 2.4 μA typ  |
| SID320   | IDACOFFSET    | All zeroes input  | –   | –   | 1    | LSB  | Polarity set by Source or Sink. Offset is 2 LSBs for 37.5 nA/LSB mode |
| SID321   | IDACGAIN      | Full-scale error less offset                              | –   | –   | ±10  | %    | –   |
| SID322   | IDACMISMATCH1 | Mismatch between IDAC1 and IDAC2 in Low mode              | –   | –   | 9.2  | LSB  | LSB = 37.5 nA typ   |
| SID322A  | IDACMISMATCH2 | Mismatch between IDAC1 and IDAC2 in Medium mode           | –   | –   | 5.6  | LSB  | LSB = 300 nA typ  |
| SID322B  | IDACMISMATCH3 | Mismatch between IDAC1 and IDAC2 in High mode             | –   | –   | 6.8  | LSB  | LSB = 2.4 μA typ  |
| SID323   | IDACSET8      | Settling time to 0.5 LSB for 8-bit IDAC                   | –   | –   | 5    | μs   | Full-scale transition. No external load.                              |
| SID324   | IDACSET7      | Settling time to 0.5 LSB for 7-bit IDAC                   | –   | –   | 5    | μs   | Full-scale transition. No external load.                              |
| SID325   | CMOD          | External modulator capacitor                              | –   | 2.2 | –    | nF   | 5-V rating, X7R or NP0 cap  |

### 4.3.6 10-bit CAPSENSE™ ADC

**Table 18 10-bit CAPSENSE™ ADC specifications**

| Spec ID# | Parameter | Description   | Min              | Typ | Max              | Unit | Details/conditions  |
|----------|-----------|---|------------------|-----|------------------|------|---|
| SIDA94   | A_RES     | Resolution  | –                | –   | 10               | bits | Auto-zeroing is required every millisecond  |
| SIDA95   | A_CHNLS_S | Number of channels - single ended   | –                | –   | 16               |      | Defined by AMUX Bus   |
| SIDA97   | A-MONO    | Monotonicity  | –                | –   | –                | Yes  | –   |
| SIDA98   | A_GAINERR | Gain error  | –                | –   | ±3               | %    | In V <sub>REF</sub> (2.4 V) mode with V <sub>DDA</sub> bypass capacitance of 10 μF      |
| SIDA99   | A_OFFSET  | Input offset voltage  | –                | –   | ±18              | mV   | In V <sub>REF</sub> (2.4 V) mode with V <sub>DDA</sub> bypass capacitance of 10 μF      |
| SIDA101  | A_VINS    | Input voltage range - single ended  | V <sub>SSA</sub> | –   | V <sub>DDA</sub> | V    | –   |
| SIDA103  | A_INRES   | Input resistance  | –                | 2.2 | –                | KΩ   | –   |
| SIDA104  | A_INCAP   | Input capacitance   | –                | 20  | –                | pF   | –   |
| SIDA106  | A_PSRR    | Power supply rejection ratio  | –                | 60  | –                | dB   | In V <sub>REF</sub> (2.4 V) mode with V <sub>DDA</sub> bypass capacitance of 10 μF      |
| SIDA107  | A_TACQ    | Sample acquisition time   | –                | 1   | –                | μs   | –   |
| SIDA108  | A_CONV8   | Conversion time for 8-bit resolution at conversion rate = F <sub>clk</sub> /(2 <sup>(N+2)</sup> ). Clock frequency = 48 MHz.  | –                | –   | 21.3             | μs   | Does not include acquisition time. Equivalent to 44.8 ksp/s including acquisition time. |
| SIDA108A | A_CONV10  | Conversion time for 10-bit resolution at conversion rate = F <sub>clk</sub> /(2 <sup>(N+2)</sup> ). Clock frequency = 48 MHz. | –                | –   | 85.3             | μs   | Does not include acquisition time. Equivalent to 11.6 ksp/s including acquisition time. |
| SIDA109  | A_SND     | Signal-to-noise and Distortion ratio (SINAD)  | –                | 61  | –                | dB   | With 10-Hz input sine wave, external 2.4-V reference, V <sub>REF</sub> (2.4 V) mode.    |
| SIDA110  | A_BW      | Input bandwidth without aliasing  | –                | –   | 22.4             | KHz  | 8-bit resolution  |
| SIDA111  | A_INL     | Integral Non Linearity. 1 ksp/s   | –                | –   | 2                | LSB  | V <sub>REF</sub> = 2.4 V or greater   |
| SIDA112  | A_DNL     | Differential Non Linearity. 1 ksp/s   | –                | –   | 1                |      | –   |

## 4.4 Digital peripherals

### 4.4.1 Timer counter pulse-width modulator (TCPWM)

**Table 19 TCPWM specifications**

| Spec ID      | Parameter             | Description                         | Min  | Typ | Max | Units | Details/conditions   |
|--------------|-----------------------|-------------------------------------|------|-----|-----|-------|--|
| SID.TCPWM.1  | ITCPWM1               | Block current consumption at 3 MHz  | –    | –   | 45  | μA    | All modes (TCPWM)  |
| SID.TCPWM.2  | ITCPWM2               | Block current consumption at 12 MHz | –    | –   | 155 |       | All modes (TCPWM)  |
| SID.TCPWM.2A | ITCPWM3               | Block current consumption at 48 MHz | –    | –   | 650 |       | All modes (TCPWM)  |
| SID.TCPWM.3  | TCPWM <sub>FREQ</sub> | Operating frequency                 | –    | –   | Fc  | MHz   | Fc max = CLK_SYS<br>Maximum = 48 MHz   |
| SID.TCPWM.4  | TPWM <sub>ENEXT</sub> | Input trigger pulse width           | 2/Fc | –   | –   | ns    | For all trigger events <sup>[5]</sup>  |
| SID.TCPWM.5  | TPWM <sub>EXT</sub>   | Output trigger pulse widths         | 2/Fc | –   | –   |       | Minimum possible width of Overflow, Underflow, and CC (Counter equals Compare value) outputs |
| SID.TCPWM.5A | TC <sub>RES</sub>     | Resolution of counter               | 1/Fc | –   | –   |       | Minimum time between successive counts   |
| SID.TCPWM.5B | PWM <sub>RES</sub>    | PWM resolution                      | 1/Fc | –   | –   |       | Minimum pulse width of PWM Output  |
| SID.TCPWM.5C | Q <sub>RES</sub>      | Quadrature inputs resolution        | 1/Fc | –   | –   |       | Minimum pulse width between Quadrature phase inputs  |

Electrical specifications

## 4.4.2 I<sup>2</sup>C

**Table 20 Fixed I<sup>2</sup>C DC specifications<sup>[5]</sup>**

| Spec ID# | Parameter         | Description                                 | Min | Typ | Max | Unit | Details/conditions |
|----------|-------------------|---|-----|-----|-----|------|--------------------|
| SID149   | I <sub>I2C1</sub> | Block current consumption at 100 kHz        | –   | –   | 50  | μA   | –                  |
| SID150   | I <sub>I2C2</sub> | Block current consumption at 400 kHz        | –   | –   | 135 |      | –                  |
| SID151   | I <sub>I2C3</sub> | Block current consumption at 1 Mbps         | –   | –   | 310 |      | –                  |
| SID152   | I <sub>I2C4</sub> | I <sup>2</sup> C enabled in Deep Sleep mode | –   | 1   | –   |      | –                  |

**Table 21 Fixed I<sup>2</sup>C AC specifications<sup>[5]</sup>**

| Spec ID# | Parameter         | Description | Min | Typ | Max | Unit | Details/conditions |
|----------|-------------------|-------------|-----|-----|-----|------|--------------------|
| SID153   | F <sub>I2C1</sub> | Bit rate    | –   | –   | 1   | Msps | –                  |

### Note

5. Guaranteed by characterization.

Electrical specifications

### 4.4.3 SPI

**Table 22 SPI DC specifications<sup>[6]</sup>**

| Spec ID# | Parameter | Description                         | Min | Typ | Max | Unit | Details/conditions |
|----------|-----------|-------------------------------------|-----|-----|-----|------|--------------------|
| SID163   | ISPI1     | Block current consumption at 1 Mbps | -   | -   | 360 | μA   | -                  |
| SID164   | ISPI2     | Block current consumption at 4 Mbps | -   | -   | 560 |      | -                  |
| SID165   | ISPI3     | Block current consumption at 8 Mbps | -   | -   | 600 |      | -                  |

**Table 23 SPI AC specifications<sup>[6]</sup>**

| Spec ID# | Parameter | Description                                       | Min | Typ | Max | Unit | Details/conditions |
|----------|-----------|---|-----|-----|-----|------|--------------------|
| SID166   | FSPI      | SPI Operating frequency (Master; 6X Oversampling) | -   | -   | 8   | MHz  | -                  |

**Fixed SPI Master mode AC specifications**

|        |      |                                       |    |   |    |    |                                  |
|--------|------|---------------------------------------|----|---|----|----|----------------------------------|
| SID167 | TDMO | MOSI Valid after SClk driving edge    | -  | - | 15 | ns | -                                |
| SID168 | TDSI | MISO Valid before SClk capturing edge | 20 | - | -  |    | Full clock, late MISO sampling   |
| SID169 | THMO | Previous MOSI data hold time          | 0  | - | -  |    | Referred to Slave capturing edge |

**Fixed SPI Slave mode AC specifications**

|         |           |  |    |   |                 |    |                                       |
|---------|-----------|--|----|---|-----------------|----|---------------------------------------|
| SID170  | TDMI      | MOSI Valid before Sclck Capturing edge               | 40 | - | -               | ns | -                                     |
| SID171  | TDSO      | MISO Valid after Sclck driving edge                  | -  | - | 42 + (3 × Tcpu) |    | T <sub>CPU</sub> = 1/F <sub>CPU</sub> |
| SID171A | TDSO_EXT  | MISO Valid after Sclck driving edge in Ext. Clk mode | -  | - | 48              |    | -                                     |
| SID172  | THSO      | Previous MISO data hold time                         | 0  | - | -               |    | -                                     |
| SID172A | TSSELSSCK | SSEL Valid to first SCK Valid edge                   | -  | - | 100             | ns | -                                     |

**Note**

6. Guaranteed by characterization.

Electrical specifications

#### 4.4.4 UART

**Table 24** UART DC specifications<sup>[7]</sup>

| Spec ID# | Parameter          | Description                            | Min | Typ | Max | Unit | Details/conditions |
|----------|--------------------|--|-----|-----|-----|------|--------------------|
| SID160   | I <sub>UART1</sub> | Block current consumption at 100 Kbps  | –   | –   | 55  | μA   | –                  |
| SID161   | I <sub>UART2</sub> | Block current consumption at 1000 Kbps | –   | –   | 312 | μA   | –                  |

**Table 25** UART AC specifications<sup>[7]</sup>

| Spec ID# | Parameter         | Description | Min | Typ | Max | Unit | Details/conditions |
|----------|-------------------|-------------|-----|-----|-----|------|--------------------|
| SID162   | F <sub>UART</sub> | Bit rate    | –   | –   | 1   | Mbps | –                  |

#### 4.4.5 LCD Direct Drive

**Table 26** LCD Direct Drive DC specifications<sup>[7]</sup>

| Spec ID# | Parameter             | Description  | Min | Typ | Max  | Unit | Details/conditions                  |
|----------|-----------------------|--|-----|-----|------|------|-------------------------------------|
| SID154   | I <sub>LCDLOW</sub>   | Operating current in low power mode                    | –   | 5   | –    | μA   | 16 × 4 small segment disp. at 50 Hz |
| SID155   | C <sub>LCDCAP</sub>   | LCD capacitance per segment/common driver              | –   | 500 | 5000 | pF   | –                                   |
| SID156   | LCD <sub>OFFSET</sub> | Long-term segment offset                               | –   | 20  | –    | mV   | –                                   |
| SID157   | I <sub>LCDOP1</sub>   | LCD system operating current V <sub>bias</sub> = 5 V   | –   | 2   | –    | mA   | 32 × 4 segments at 50 Hz, 25°C      |
| SID158   | I <sub>LCDOP2</sub>   | LCD system operating current V <sub>bias</sub> = 3.3 V | –   | 2   | –    |      | 32 × 4 segments at 50 Hz, 25°C      |

**Table 27** LCD Direct Drive AC specifications<sup>[7]</sup>

| Spec ID# | Parameter        | Description    | Min | Typ | Max | Unit | Details/conditions |
|----------|------------------|----------------|-----|-----|-----|------|--------------------|
| SID159   | F <sub>LCD</sub> | LCD frame rate | 10  | 50  | 150 | Hz   | –                  |

**Note**

7. Guaranteed by characterization.

Electrical specifications

## 4.5 Memory

### 4.5.1 Flash

**Table 28 Flash DC specifications**

| Spec ID# | Parameter       | Description               | Min  | Typ | Max | Unit | Details/conditions |
|----------|-----------------|---------------------------|------|-----|-----|------|--------------------|
| SID173   | V <sub>PE</sub> | Erase and program voltage | 1.71 | –   | 5.5 | V    | –                  |

**Table 29 Flash AC specifications**

| Spec ID#               | Parameter                              | Description  | Min  | Typ | Max | Unit    | Details/conditions       |
|------------------------|--|--|------|-----|-----|---------|--------------------------|
| SID174                 | T <sub>ROWWRITE</sub> <sup>[8]</sup>   | Row (block) write time (erase and program)   | –    | –   | 20  | ms      | Row (block) = 256 bytes  |
| SID175                 | T <sub>ROWERASE</sub> <sup>[8]</sup>   | Row erase time   | –    | –   | 16  |         | –                        |
| SID176                 | T <sub>ROWPROGRAM</sub> <sup>[8]</sup> | Row program time after erase   | –    | –   | 4   |         | –                        |
| SID178                 | T <sub>BULKERASE</sub> <sup>[8]</sup>  | Bulk erase time (64 KB)  | –    | –   | 35  |         | –                        |
| SID180 <sup>[8]</sup>  | T <sub>DEVPROG</sub> <sup>[8]</sup>    | Total device program time  | –    | –   | 7   | Seconds | –                        |
| SID181 <sup>[8]</sup>  | F <sub>END</sub>                       | Flash endurance  | 100K | –   | –   | Cycles  | –                        |
| SID182 <sup>[8]</sup>  | F <sub>RET</sub>                       | Flash retention.<br>T <sub>A</sub> ≤ 55°C,<br>100K P/E cycles  | 20   | –   | –   | Years   | –                        |
| SID182A <sup>[8]</sup> | F <sub>RET</sub>                       | Flash retention.<br>T <sub>A</sub> ≤ 85°C,<br>10K P/E cycles   | 10   | –   | –   |         | –                        |
| SID182B                | F <sub>RETQ</sub>                      | Flash retention.<br>T <sub>A</sub> ≤ 105°C,<br>10K P/E cycles with no more than 3 years at T <sub>A</sub> > 85°C | 10   | –   | –   |         | Guaranteed by design     |
| SID256                 | TWS48                                  | Number of Wait states at 48 MHz  | 2    | –   | –   |         | CPU execution from Flash |
| SID257                 | TWS24                                  | Number of Wait states at 24 MHz  | 1    | –   | –   |         | CPU execution from Flash |

#### Note

8. It can take as much as 20 milliseconds to write to Flash. During this time the device should not be Reset, or Flash operations will be interrupted and cannot be relied on to have completed. Reset sources include the XRES pin, software resets, CPU lockup states and privilege violations, improper power supply levels, and watchdogs. Make certain that these are not inadvertently activated.

Electrical specifications

## 4.6 System resources

### 4.6.1 Power-on reset (POR)

**Table 30 Power-on reset (PRES)**

| Spec ID#               | Parameter             | Description            | Min              | Typ | Max | Units | Details/conditions         |
|------------------------|-----------------------|------------------------|------------------|-----|-----|-------|----------------------------|
| SID.CLK#6              | SR_POWER              | Power supply slew rate | 1 <sup>[9]</sup> | –   | 67  | V/ms  | On power-up and power-down |
| SID185 <sup>[10]</sup> | V <sub>RISEIPOR</sub> | Rising trip voltage    | 0.80             | –   | 1.5 | V     | –                          |
| SID186 <sup>[10]</sup> | V <sub>FALLIPOR</sub> | Falling trip voltage   | 0.70             | –   | 1.4 |       | –                          |

### 4.6.2 Brown-out detect (BOD)

**Table 31 Brown-out detect (BOD) for V<sub>CCD</sub>**

| Spec ID#               | Parameter              | Description                                | Min  | Typ | Max  | Unit | Details/conditions |
|------------------------|------------------------|--|------|-----|------|------|--------------------|
| SID190 <sup>[10]</sup> | V <sub>FALLPPOR</sub>  | BOD trip voltage in active and sleep modes | 1.48 | –   | 1.62 | V    | –                  |
| SID192 <sup>[10]</sup> | V <sub>FALLDPSLP</sub> | BOD trip voltage in Deep Sleep             | 1.11 | –   | 1.5  |      | –                  |

### 4.6.3 SWD interface

**Table 32 SWD interface specifications**

| Spec ID#                | Parameter    | Description                                   | Min             | Typ | Max            | Unit | Details/conditions                    |
|-------------------------|--------------|---|-----------------|-----|----------------|------|---------------------------------------|
| SID213                  | F_SWDCCLK1   | $3.3\text{ V} \leq V_{DD} \leq 5.5\text{ V}$  | –               | –   | 14             | MHz  | SWDCLK $\leq$ 1/3 CPU clock frequency |
| SID214                  | F_SWDCCLK2   | $1.71\text{ V} \leq V_{DD} \leq 3.3\text{ V}$ | –               | –   | 7              |      | SWDCLK $\leq$ 1/3 CPU clock frequency |
| SID215 <sup>[10]</sup>  | T_SWDI_SETUP | $T = 1/f\text{ SWDCLK}$                       | $0.25 \times T$ | –   | –              | ns   | –                                     |
| SID216 <sup>[10]</sup>  | T_SWDI_HOLD  | $T = 1/f\text{ SWDCLK}$                       | $0.25 \times T$ | –   | –              |      | –                                     |
| SID217 <sup>[10]</sup>  | T_SWDO_VALID | $T = 1/f\text{ SWDCLK}$                       | –               | –   | $0.5 \times T$ |      | –                                     |
| SID217A <sup>[10]</sup> | T_SWDO_HOLD  | $T = 1/f\text{ SWDCLK}$                       | 1               | –   | –              |      | –                                     |

#### Notes

9. If minimum ramp rate cannot be met, XRES should be asserted during voltage ramp ( $1.5\text{ V} > V_{DD} > 1.0\text{ V}$  for ramp-down or until voltage is stable for ramp-up). Note that a glitch on the I2C bus could occur during voltage ramp in this case.

10. Guaranteed by characterization.

Electrical specifications

#### 4.6.4 Internal main oscillator

**Table 33 IMO DC specifications**

(Guaranteed by design)

| Spec ID# | Parameter  | Description                     | Min | Typ | Max | Unit | Details/conditions |
|----------|------------|---------------------------------|-----|-----|-----|------|--------------------|
| SID218   | $I_{IMO1}$ | IMO operating current at 48 MHz | –   | –   | 250 | μA   | –                  |
| SID219   | $I_{IMO2}$ | IMO operating current at 24 MHz | –   | –   | 180 | μA   | –                  |

**Table 34 IMO AC specifications**

| Spec ID# | Parameter        | Description   | Min | Typ | Max   | Unit | Details/conditions                    |
|----------|------------------|---|-----|-----|-------|------|---------------------------------------|
| SID223   | $F_{IMOTOL1}$    | Frequency variation at 24, 32, and 48 MHz (trimmed) | –   | –   | ±2    | %    | –40°C ≤ TA ≤ 105°C                    |
| SID223A  | $F_{IMOTOL1A}$   | Frequency variation at 24, 32, and 48 MHz (trimmed) | –   | –   | ±2.5  | %    | –40°C ≤ TA ≤ 125°C                    |
| SID333   | $IMO_{WCO}$      | All IMO settings                                    | –   | –   | ±0.25 | %    | IMO variation in WCO-locked DPLL mode |
| SID226   | $T_{STARTIMO}$   | IMO startup time                                    | –   | –   | 7     | μs   | –                                     |
| SID228   | $T_{JITRMSIMO2}$ | RMS jitter at 24 MHz                                | –   | 145 | –     | ps   | –                                     |

Electrical specifications

## 4.6.5 Internal low-speed oscillator

**Table 35 ILO DC specifications**

(Guaranteed by design)

| Spec ID# | Parameter         | Description           | Min | Typ | Max  | Unit | Details/conditions |
|----------|-------------------|-----------------------|-----|-----|------|------|--------------------|
| SID231   | I <sub>ILO1</sub> | ILO operating current | –   | 0.3 | 1.05 | µA   | –                  |

**Table 36 ILO AC specifications**

| Spec ID#               | Parameter              | Description         | Min | Typ | Max | Unit | Details/conditions |
|------------------------|------------------------|---------------------|-----|-----|-----|------|--------------------|
| SID234 <sup>[11]</sup> | T <sub>STARTILO1</sub> | ILO startup time    | –   | –   | 2   | ms   | –                  |
| SID236 <sup>[11]</sup> | T <sub>ILODUTY</sub>   | ILO duty cycle      | 40  | 50  | 60  | %    | –                  |
| SID237                 | F <sub>ILOTRIM1</sub>  | ILO frequency range | 20  | 40  | 80  | kHz  | –                  |

## 4.6.6 Watch crystal oscillator (WCO)

**Table 37 WCO specifications**

| Spec ID# | Parameter | Description                         | Min | Typ    | Max  | Unit | Details/conditions  |
|----------|-----------|-------------------------------------|-----|--------|------|------|---------------------|
| SID398   | FWCO      | Crystal frequency                   | –   | 32.768 | –    | kHz  | –                   |
| SID399   | FTOL      | Frequency tolerance                 | –   | 50     | 250  | ppm  | With 20-ppm crystal |
| SID400   | ESR       | Equivalent series resistance        | –   | 50     | –    | kΩ   | –                   |
| SID401   | PD        | Drive Level                         | –   | –      | 1    | µW   | –                   |
| SID402   | TSTART    | Startup time                        | –   | –      | 500  | ms   | –                   |
| SID403   | CL        | Crystal Load Capacitance            | 6   | –      | 12.5 | pF   | –                   |
| SID404   | C0        | Crystal Shunt Capacitance           | –   | 1.35   | –    | pF   | –                   |
| SID405   | IWCO1     | Operating Current (high power mode) | –   | –      | 8    | µA   | –                   |

## 4.6.7 External clock

**Table 38 External clock specifications**

| Spec ID#               | Parameter  | Description                               | Min | Typ | Max | Unit | Details/conditions |
|------------------------|------------|---|-----|-----|-----|------|--------------------|
| SID305 <sup>[12]</sup> | ExtClkFreq | External clock input frequency            | 0   | –   | 48  | MHz  | –40°C ≤ TA ≤ 85°C  |
| SID306 <sup>[12]</sup> | ExtClkDuty | Duty cycle; measured at V <sub>DD/2</sub> | 45  | –   | 55  | %    | –40°C ≤ TA ≤ 85°C  |

**Notes**

- 11. Guaranteed by characterization.
- 12. Guaranteed by design.

Electrical specifications

#### 4.6.8 External crystal oscillator and PLL

**Table 39 External crystal oscillator (ECO) specifications**

| Spec ID#               | Parameter | Description                    | Min | Typ | Max | Unit | Details/conditions |
|------------------------|-----------|--------------------------------|-----|-----|-----|------|--------------------|
| SID316 <sup>[13]</sup> | IECO1     | External clock input frequency | –   | –   | 1.5 | mA   | –                  |
| SID317 <sup>[13]</sup> | FECO      | Crystal frequency range        | 4   | –   | 33  | MHz  | –                  |

**Table 40 PLL specifications**

| Spec ID# | Parameter   | Description   | Min  | Typ | Max | Unit | Details/conditions                        |
|----------|-------------|---|------|-----|-----|------|---|
| SID410   | IDD_PLL_48  | In = 3 MHz, Out = 48 MHz  | –    | 530 | 610 | μA   | –   |
| SID411   | IDD_PLL_24  | In = 3 MHz, Out = 24 MHz  | –    | 300 | 405 | μA   | –   |
| SID412   | Fp1lin      | PLL input frequency   | 1    | –   | 48  | MHz  | –   |
| SID413   | Fp1lint     | PLL intermediate frequency; prescaler out                             | 1    | –   | 3   | MHz  | –   |
| SID414   | Fp1lvco     | VCO output frequency before post-divide                               | 22.5 | –   | 104 | MHz  | –   |
| SID415   | Divvco      | VCO Output post-divider range; PLL output frequency is Fp1lvco/Divvco | 1    | –   | 8   | –    | –   |
| SID416   | Plllocktime | Lock time at startup  | –    | –   | 250 | μs   | –   |
| SID417   | Jperiod_1   | Period jitter for VCO ≥ 67 MHz  | –    | –   | 150 | ps   | Guaranteed by design<br>–40°C ≤ TA ≤ 85°C |
| SID416A  | Jperiod_2   | Period jitter for VCO ≤ 67 MHz  | –    | –   | 200 | ps   | Guaranteed by design<br>–40°C ≤ TA ≤ 85°C |

Electrical specifications

## 4.6.9 System clock

**Table 41 Block specs**

| Spec ID#               | Parameter              | Description                        | Min | Typ | Max | Unit    | Details/conditions |
|------------------------|------------------------|------------------------------------|-----|-----|-----|---------|--------------------|
| SID262 <sup>[13]</sup> | T <sub>CLKSWITCH</sub> | System clock source switching time | 3   | –   | 4   | Periods | –                  |

## 4.6.10 Smart I/O

**Table 42 Smart I/O pass-through time (Delay in Bypass Mode)**

| Spec ID# | Parameter  | Description                                 | Min | Typ | Max | Unit | Details/conditions |
|----------|------------|---|-----|-----|-----|------|--------------------|
| SID252   | PRG_BYPASS | Max delay added by Smart I/O in bypass mode | –   | –   | 1.6 | ns   | –                  |

## 4.6.11 CAN

**Table 43 CAN specifications**

| Spec ID# | Parameter | Description               | Min | Typ | Max | Unit | Details/conditions |
|----------|-----------|---------------------------|-----|-----|-----|------|--------------------|
| SID420   | IDD_CAN   | Block current consumption | –   | –   | 200 | μA   | –                  |
| SID421   | CAN_bits  | CAN Bit rate              | –   | –   | 1   | Mbps | Min 8-MHz clock    |

**Note**

13. Guaranteed by characterization.

## 5 Ordering information

**Table 44** lists the marketing part numbers (MPNs) for the PSoC™ 4100S Plus devices<sup>[14]</sup>.

**Table 44** Ordering information

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            |     |     |            | Packages |      |            |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|-----|-----|------------|----------|------|------------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO | ECO | Smart I/Os | CAN      | GPIO | 48-pin QFN |
| CY8C4126AZA-S455 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZA-S245 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZA-S255 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZA-S265 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZA-S275 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZA-S455 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4127AZA-S445 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4127AZA-S455 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S245 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S255 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S265 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S275 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S285 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S295 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | 1        | 54   | -          |
| CY8C4147AZA-S445 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S455 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4147AZA-S465 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | 1        | 54   | -          |
| CY8C4147AZA-S475 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | 1        | 54   | -          |
| CY8C4126AZS-S455 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZS-S245 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZS-S255 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZS-S265 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZS-S275 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4146AZS-S455 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |
| CY8C4127AZS-S445 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -        | 54   | -          |

**Note**

14. Contact **Infinion Support** for the availability of Grade-E devices.

**Table 44** Ordering information (continued)

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            | Packages |     |            |     |      |            |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|----------|-----|------------|-----|------|------------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO      | ECO | Smart I/Os | CAN | GPIO | 48-pin QFN |
| CY8C4127AZS-S455 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZS-S245 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZS-S255 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZS-S265 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZS-S275 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZS-S285 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147AZS-S295 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147AZS-S445 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZS-S455 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZS-S465 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147AZS-S475 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4126LQA-S453 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4146LQA-S243 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4146LQA-S253 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4146LQA-S263 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4146LQA-S273 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4146LQA-S453 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4127LQA-S443 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4127LQA-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S263 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S283 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S293 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | 1   | 34   | -          |
| CY8C4147LQA-S443 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S453 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |
| CY8C4147LQA-S463 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | 1   | 34   | -          |
| CY8C4147LQA-S473 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | 1   | 34   | -          |
| CY8C4126LQS-S453 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | -          |

**Note**

14. Contact [Infineon Support](#) for the availability of Grade-E devices.

**Table 44** Ordering information (continued)

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            |     |     | Packages |            |     |      |            |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|-----|-----|----------|------------|-----|------|------------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO | ECO |          | Smart I/Os | CAN | GPIO |            |
| CY8C4146LQS-S243 | 48                  | 64         | 8         | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   | 48-pin QFN |
| CY8C4146LQS-S253 | 48                  | 64         | 8         | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4146LQS-S263 | 48                  | 64         | 8         | -   | -            | X         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4146LQS-S273 | 48                  | 64         | 8         | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4146LQS-S453 | 48                  | 64         | 8         | -   | 2            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4127LQS-S443 | 24                  | 128        | 16        | -   | 2            | -         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4127LQS-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQS-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQS-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQS-S263 | 48                  | 128        | 16        | -   | -            | X         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQS-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQS-S283 | 48                  | 128        | 16        | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | 1   | 34   |            |
| CY8C4147LQS-S293 | 48                  | 128        | 16        | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | 1   | 34   |            |
| CY8C4147LQS-S443 | 48                  | 128        | 16        | -   | 2            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQS-S453 | 48                  | 128        | 16        | -   | 2            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4146LQE-S243 | 48                  | 64         | 8         | -   | -            | -         | -                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4146LQE-S253 | 48                  | 64         | 8         | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4146LQE-S263 | 48                  | 64         | 8         | -   | -            | X         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4146LQE-S273 | 48                  | 64         | 8         | -   | 2            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4127LQE-S443 | 24                  | 128        | 16        | -   | 2            | -         | -                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4127LQE-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S263 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S443 | 24                  | 128        | 16        | -   | 2            | -         | -                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S263 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S443 | 24                  | 128        | 16        | -   | 2            | -         | -                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S263 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S443 | 24                  | 128        | 16        | -   | 2            | -         | -                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S263 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S443 | 24                  | 128        | 16        | -   | 2            | -         | -                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S263 | 48                  | 128        | 16        | -   | -            | -         | -                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | -              | 1000 Ksps      | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S443 | 24                  | 128        | 16        | -   | 2            | -         | -                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |
| CY8C4147LQE-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | -              | 806 Ksps       | 2            | 8          | 4   | X   | X        | 24         | -   | 34   |            |

**Note**

14. Contact [Infineon Support](#) for the availability of Grade-E devices.

**Table 44 Ordering information (continued)**

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            | Packages |     |            |     |      |            |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|----------|-----|------------|-----|------|------------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO      | ECO | Smart I/Os | CAN | GPIO | 48-pin QFN |
| CY8C4147LQE-S293 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | 1   | 34   | X          |
| CY8C4147LQE-S443 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | X          |
| CY8C4147LQE-S453 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 34   | X          |
| CY8C4147LQE-S463 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | 1   | 34   | X          |
| CY8C4147LQE-S473 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | 1   | 34   | X          |
| CY8C4126AZE-S455 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146AZE-S245 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4146AZE-S255 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4146AZE-S265 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4146AZE-S275 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4146AZE-S455 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4127AZE-S445 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4127AZE-S455 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZE-S245 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4147AZE-S255 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4147AZE-S265 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4147AZE-S275 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4147AZE-S285 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | -          | -   | 54   | -          |
| CY8C4147AZE-S295 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147AZE-S445 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZE-S455 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147AZE-S465 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147AZE-S475 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4126LQA-S455 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQA-S245 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQA-S255 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQA-S265 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQA-S275 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQA-S455 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4127LQA-S445 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |

**Note**

14. Contact **Infinion Support** for the availability of Grade-E devices.

**Table 44** Ordering information (continued)

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            |     |     | Packages   |     |      |            |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|-----|-----|------------|-----|------|------------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO | ECO | Smart I/Os | CAN | GPIO | 48-pin QFN |
| CY8C4127LQA-S455 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQA-S245 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQA-S255 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQA-S265 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQA-S275 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQA-S285 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | 1   | 54   | -          |
| CY8C4147LQA-S295 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | 1   | 54   | -          |
| CY8C4147LQA-S445 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQA-S455 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4146LQS-S245 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4146LQS-S255 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4146LQS-S265 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4146LQS-S275 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4146LQS-S455 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4127LQS-S445 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4127LQS-S455 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQS-S245 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQS-S255 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQS-S265 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQS-S275 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQS-S285 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | 1   | 54   | -          |
| CY8C4147LQS-S295 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | 1   | 54   | -          |
| CY8C4147LQS-S445 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4147LQS-S455 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |
| CY8C4126LQE-S455 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X   | X   | 24         | -   | 54   | -          |

**Note**

14. Contact **Infinion Support** for the availability of Grade-E devices.

**Table 44** Ordering information (continued)

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            | Packages |     |            |     |      |            |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|----------|-----|------------|-----|------|------------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO      | ECO | Smart I/Os | CAN | GPIO | 48-pin QFN |
| CY8C4146LQE-S245 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQE-S255 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQE-S265 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQE-S275 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4146LQE-S455 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4127LQE-S445 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4127LQE-S455 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147LQE-S245 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147LQE-S255 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147LQE-S265 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147LQE-S275 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147LQE-S285 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147LQE-S295 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147LQE-S445 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147LQE-S455 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | -   | 54   | -          |
| CY8C4147LQE-S465 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4147LQE-S475 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 5          | X        | X   | 24         | 1   | 54   | -          |
| CY8C4126LDA-S453 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4146LDA-S243 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4146LDA-S253 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4146LDA-S263 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4146LDA-S273 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4146LDA-S453 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4127LDA-S443 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4127LDA-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4147LDA-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4147LDA-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4147LDA-S263 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4147LDA-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | -   | 38   | X          |
| CY8C4147LDA-S283 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X        | X   | 24         | 1   | 38   | X          |

**Note**

14. Contact [Infineon Support](#) for the availability of Grade-E devices.

**Table 44 Ordering information (continued)**

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            |     |     | Packages |            |     |      |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|-----|-----|----------|------------|-----|------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO | ECO |          | Smart I/Os | CAN | GPIO |
| CY8C4147LDA-S293 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDA-S443 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDA-S453 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDA-S463 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDA-S473 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4126LDS-S453 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDS-S243 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDS-S253 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDS-S263 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDS-S273 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDS-S453 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4127LDS-S443 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4127LDS-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDS-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDS-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDS-S263 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDS-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDS-S283 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDS-S293 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDS-S443 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDS-S453 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDS-S463 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDS-S473 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4126LDE-S453 | 24                  | 64         | 8         | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDE-S243 | 48                  | 64         | 8         | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDE-S253 | 48                  | 64         | 8         | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDE-S263 | 48                  | 64         | 8         | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDE-S273 | 48                  | 64         | 8         | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4146LDE-S453 | 48                  | 64         | 8         | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4127LDE-S443 | 24                  | 128        | 16        | -   | 2            | -         | X                | 806 Ksps       | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |

**Note**

14. Contact **Infinion Support** for the availability of Grade-E devices.

**Table 44 Ordering information (continued)**

| MPN              | Features            |            |           |     |              |           |                  |                |                |              |            |     |     | Packages |            |     |      |
|------------------|---------------------|------------|-----------|-----|--------------|-----------|------------------|----------------|----------------|--------------|------------|-----|-----|----------|------------|-----|------|
|                  | Max CPU Speed (MHz) | Flash (KB) | SRAM (KB) | UDB | Opamp (CTBm) | CAPSENSE™ | Direct LCD Drive | 12-bit SAR ADC | LP Comparators | TCPWM Blocks | SCB Blocks | WCO | ECO |          | Smart I/Os | CAN | GPIO |
| CY8C4127LDE-S453 | 24                  | 128        | 16        | -   | 2            | X         | X                | 806 Ksps       | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDE-S243 | 48                  | 128        | 16        | -   | -            | -         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDE-S253 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDE-S263 | 48                  | 128        | 16        | -   | -            | X         | -                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDE-S273 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDE-S283 | 48                  | 128        | 16        | -   | -            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDE-S293 | 48                  | 128        | 16        | -   | -            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDE-S443 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDE-S453 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | -          | 38  | X    |
| CY8C4147LDE-S463 | 48                  | 128        | 16        | -   | 2            | -         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |
| CY8C4147LDE-S473 | 48                  | 128        | 16        | -   | 2            | X         | X                | 1000 Ksps      | 2              | 8            | 4          | X   | X   | 24       | 1          | 38  | X    |

**Note**

14. Contact [Infineon Support](#) for the availability of Grade-E devices.

# Automotive PSoC™ 4: PSoC™ 4100S Plus

## Based on Arm® Cortex®-M0+ CPU



### Ordering information

The nomenclature used in the preceding table is based on the following part numbering convention:

| Field | Description                          | Values  | Meaning                                    |
|-------|--------------------------------------|---------|--|
| CY8C  | Cypress (an Infineon company) prefix |         |  |
| 4     | Architecture                         | 4       | PSoC™ 4                                    |
| A     | Family                               | 1       | 4100 family                                |
| B     | CPU speed                            | 2       | 24 MHz                                     |
|       |                                      | 4       | 48 MHz                                     |
| C     | Flash capacity                       | 4       | 16 KB                                      |
|       |                                      | 5       | 32 KB                                      |
|       |                                      | 6       | 64 KB                                      |
|       |                                      | 7       | 128 KB                                     |
| DE    | Package code                         | AZ      | TQFP (0.5-mm pitch)                        |
|       |                                      | LQ      | QFN  |
| F     | Temperature range                    | A       | Automotive (AEC-Q100: -40°C to +85°C)      |
|       |                                      | S       | Automotive (AEC-Q100: -40°C to +105°C)     |
|       |                                      | E       | Automotive (AEC-Q100: -40°C to +125°C)     |
| S     | Silicon family                       | S       | PSoC™ 4 S-Series                           |
|       |                                      | M       | PSoC™ 4 M-Series                           |
|       |                                      | L       | PSoC™ 4 L-Series                           |
|       |                                      | BL      | PSoC™ 4 Bluetooth® LE-Series               |
| XYZ   | Attributes code                      | 000–999 | Code of feature set in the specific family |

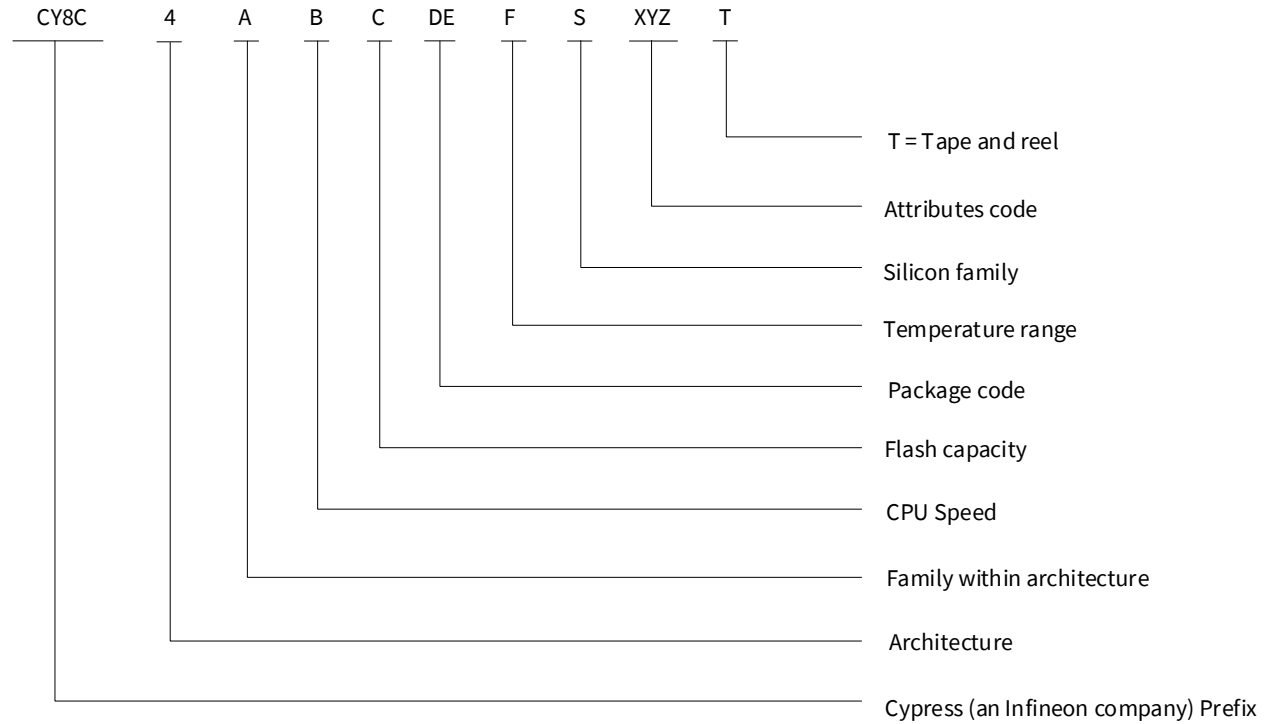
# Automotive PSoC™ 4: PSoC™ 4100S Plus

## Based on Arm® Cortex®-M0+ CPU



### Ordering information

The following is an example of a part number:



#### Example

- 4: PSoC™ 4
- 1: 4100 family
- 4: 48 MHz
- 6: 64 KB
- AZ: TQFP
- A, S, E: Automotive

Packaging

## 6 Packaging

The PSoC™ 4100S Plus will be offered in 40-pin QFN, 64-pin QFN, and 64-pin TQFP packages.

**Table 45** provides the package dimensions and Infineon drawing numbers.

**Table 45 Package list**

| Spec ID# | Package     | Description   | Package Dwg |
|----------|-------------|---|-------------|
| BID27    | 64-pin TQFP | 10 × 10 × 1.4 mm height with 0.5-mm pitch                                   | 51-85051    |
| BID27A   | 40-pin QFN  | 6 × 6 × 0.6 mm (4.6 × 4.6 mm E-Pad (Sawn, step-cut wettable flank package)) | 002-25105   |
| BID28    | 48-pin QFN  | 7.0 × 7.0 × 0.9 mm (5.5 × 5.5 mm E-Pad (Wettable flank))                    | 002-33925   |
| BID29    | 64-pin QFN  | 9.0 × 9.0 × 0.9 mm (7.70 × 7.70 mm E-Pad (Dimple wettable flank, Sawn))     | 002-31760   |

**Table 46 Package thermal characteristics**

| Parameter       | Description                    | Package     | Conditions          | Min | Typ | Max | Unit |
|-----------------|--------------------------------|-------------|---------------------|-----|-----|-----|------|
| T <sub>A</sub>  | Operating ambient temperature  | –           | For A-grade devices | –40 | 25  | 85  | °C   |
|                 |                                |             | For S-grade devices | –40 | 25  | 105 |      |
|                 |                                |             | For E-grade devices | –40 | 25  | 125 |      |
| T <sub>J</sub>  | Operating junction temperature | –           | For A-grade devices | –40 | –   | 100 |      |
|                 |                                |             | For S-grade devices | –40 | –   | 115 |      |
|                 |                                |             | For E-grade devices | –40 | –   | 140 |      |
| T <sub>JA</sub> | Package $\theta_{JA}$          | 64-pin TQFP | –                   | –   | 46  | –   | °C/W |
|                 |                                | 40-pin QFN  | –                   | –   | 25  | –   |      |
|                 |                                | 64-pin QFN  | –                   | –   | 17  | –   |      |
| T <sub>JC</sub> | Package $\theta_{JC}$          | 64-pin TQFP | –                   | –   | 10  | –   | °C/W |
|                 |                                | 40-pin QFN  | –                   | –   | 3   | –   |      |
|                 |                                | 64-pin QFN  | –                   | –   | 6   | –   |      |

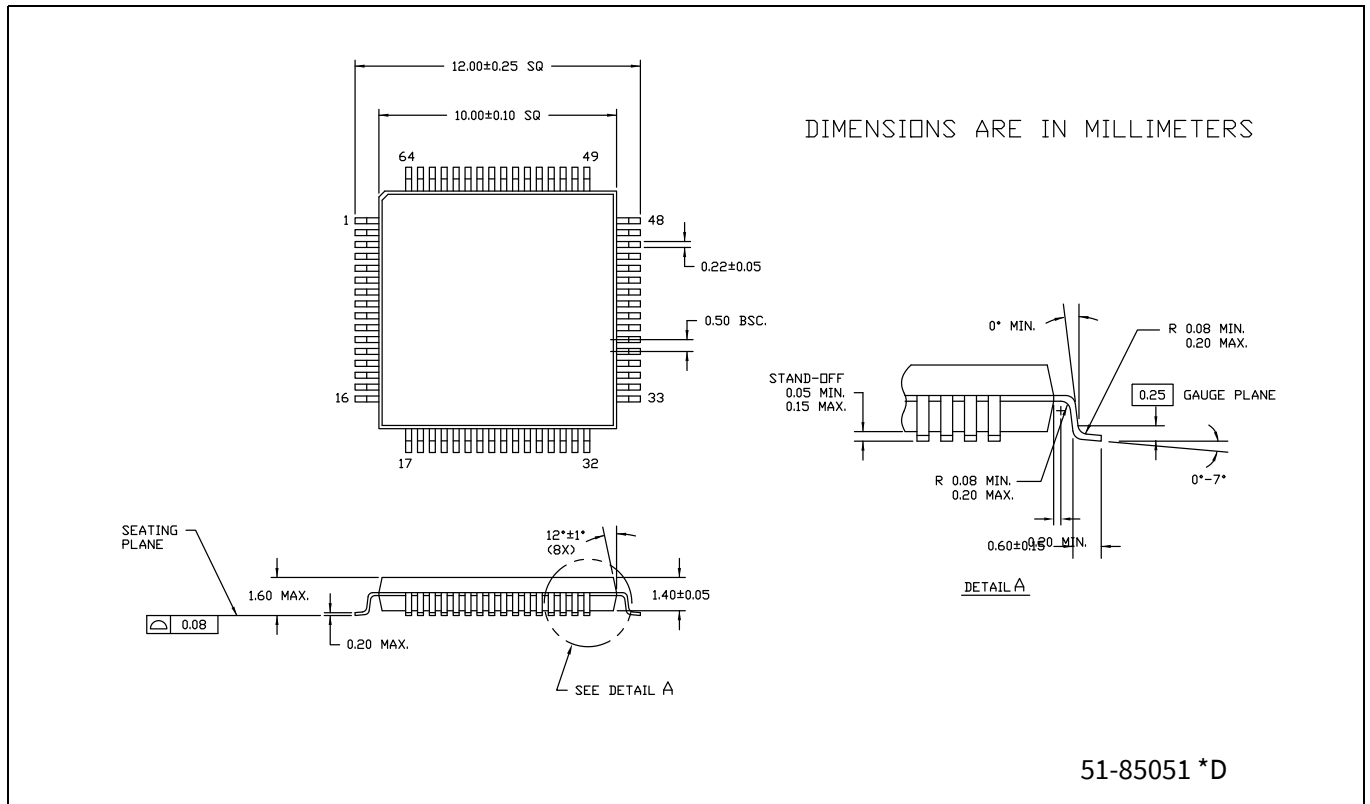
**Table 47 Solder reflow peak temperature**

| Package | Maximum peak temperature | Maximum time at peak temperature |
|---------|--------------------------|----------------------------------|
| All     | 260°C                    | 30 seconds                       |

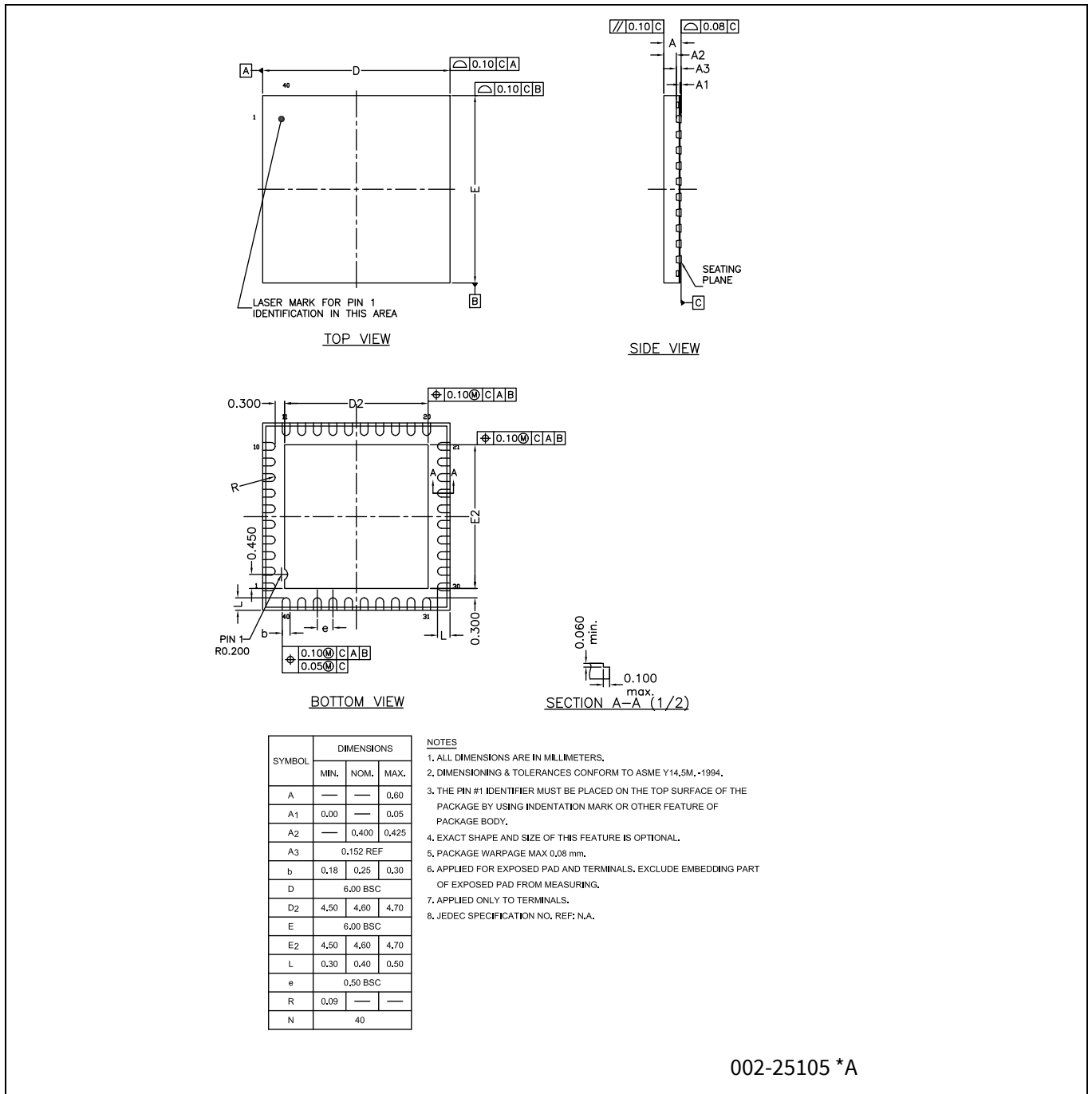
**Table 48 Package moisture sensitivity level (MSL), IPC/JEDEC J-STD-020**

| Package | MSL   |
|---------|-------|
| All     | MSL 3 |

## 6.1 Package diagrams

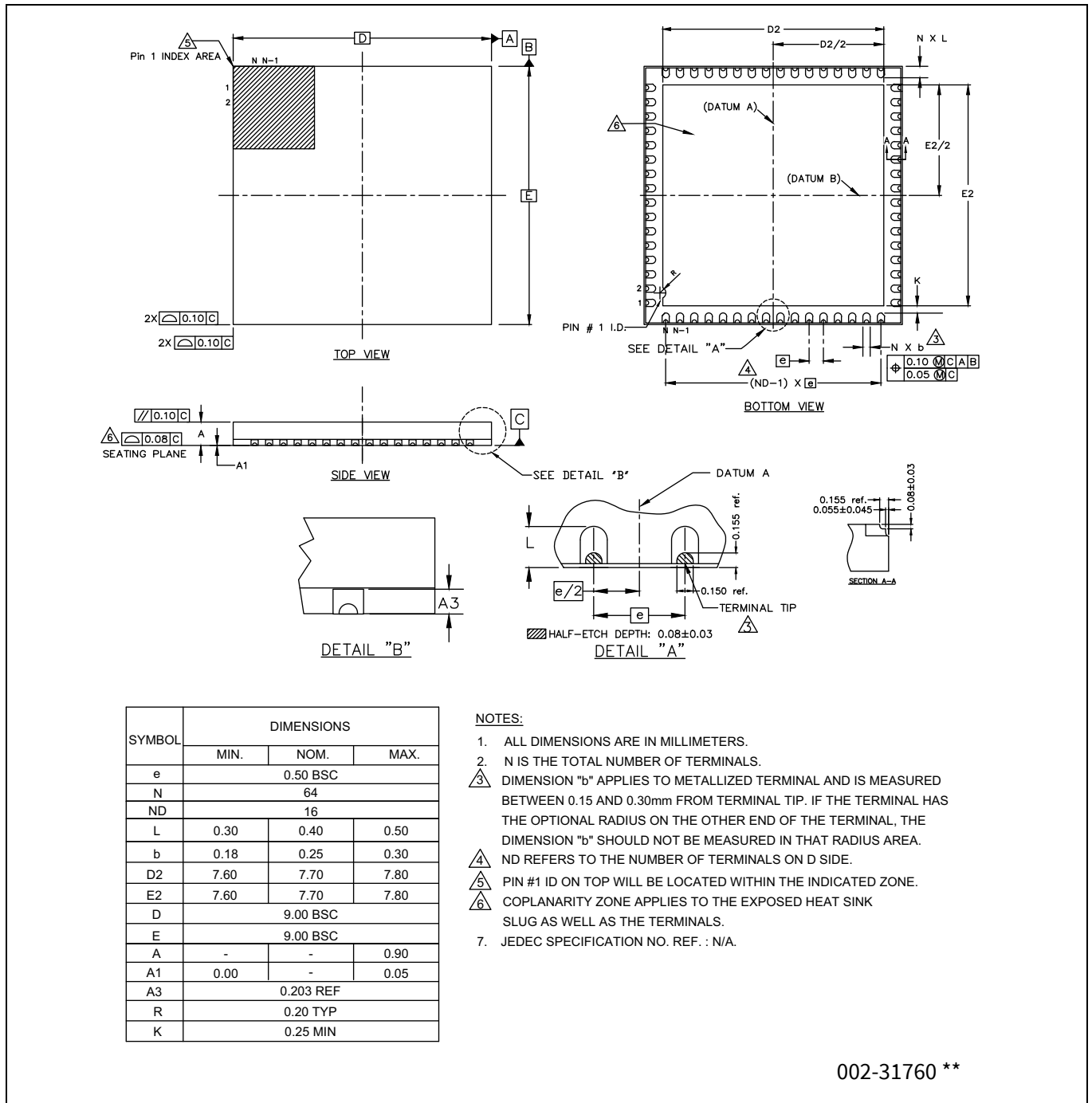


**Figure 6 64-pin TQFP (10 × 10 × 1.4 mm) A64SB package outline (PG-TQFP-64), 51-85051**



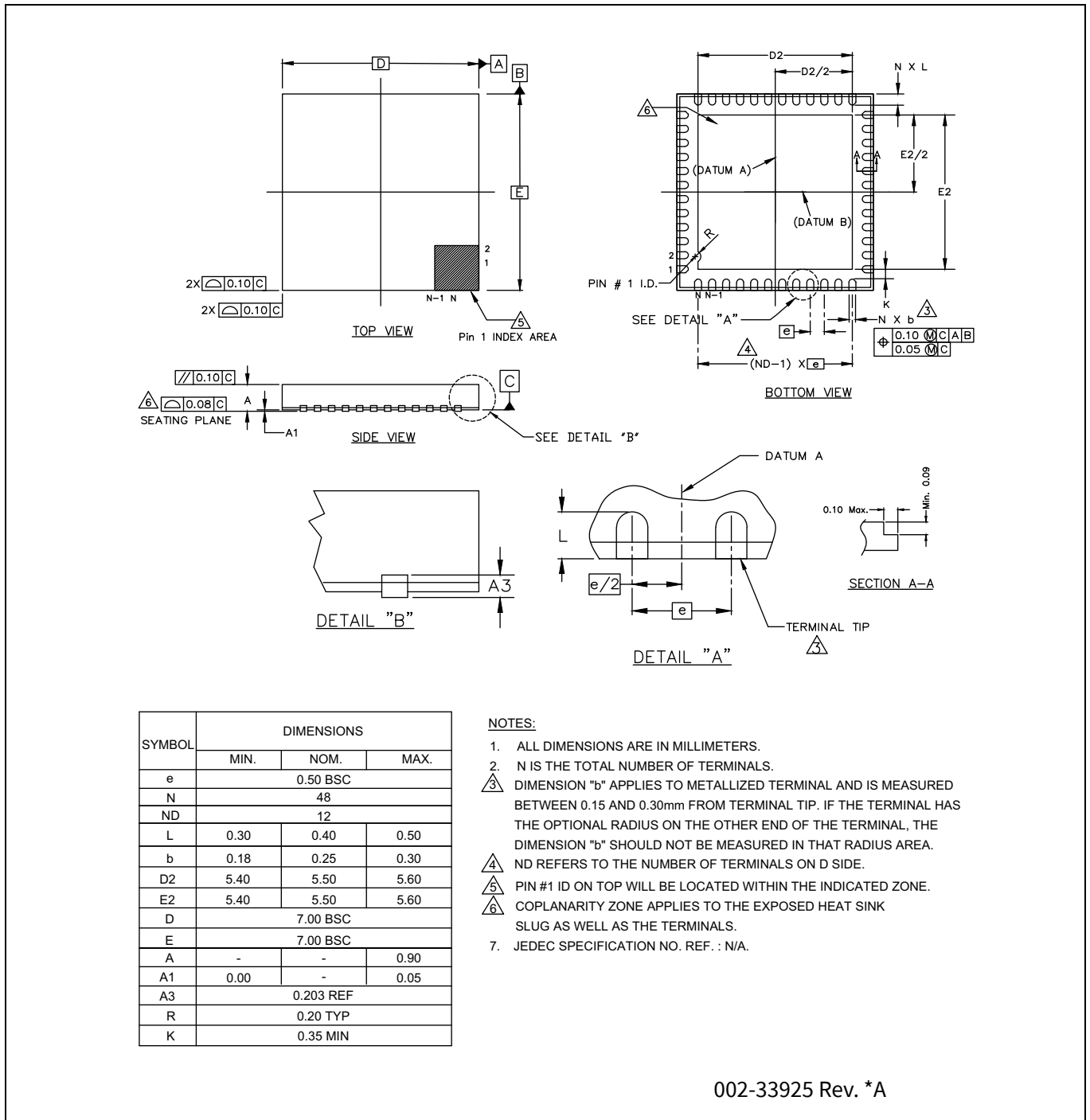
**Figure 7 40-pin QFN ((6 × 6 × 0.6 mm) LD40B 4.6 × 4.6 mm E-Pad (Sawn)) package outline (PG-VQFN-40), 002-25105**

Packaging



**Figure 8 64-pin QFN (9 × 9 × 0.9 mm) LV64A 7.70 × 7.70 mm E-Pad (Sawn)) package outline (PG-VQFN-64), 002-31760**

Packaging



**Figure 9 48-pin QFN ((7.0 x 7.0 x 0.9 mm) LV48G 5.5 x 5.5 mm E-Pad (Wettable flank)) package outline, 002-33925**

## 7 Acronyms

**Table 49 Acronyms used in this document**

| Acronym | Description  |
|---------|--|
| abus    | analog local bus   |
| ADC     | analog-to-digital converter  |
| AG      | analog global  |
| AHB     | AMBA (advanced microcontroller bus architecture) high-performance bus, an Arm® data transfer bus |
| ALU     | arithmetic logic unit  |
| AMUXBUS | analog multiplexer bus   |
| API     | application programming interface  |
| APSR    | application program status register  |
| Arm®    | advanced RISC machine, a CPU architecture  |
| ATM     | automatic thump mode   |
| BW      | bandwidth  |
| CAN     | Controller Area Network, a communications protocol   |
| CMRR    | common-mode rejection ratio  |
| CPU     | central processing unit  |
| CRC     | cyclic redundancy check, an error-checking protocol  |
| DAC     | digital-to-analog converter, see also IDAC, VDAC   |
| DFB     | digital filter block   |
| DIO     | digital input/output, GPIO with only digital capabilities, no analog. See GPIO.                  |
| DMIPS   | Dhrystone million instructions per second  |
| DMA     | direct memory access, see also TD  |
| DNL     | differential nonlinearity, see also INL  |
| DNU     | do not use   |
| DR      | port write data registers  |
| DSI     | digital system interconnect  |
| DWT     | data watchpoint and trace  |
| ECC     | error correcting code  |
| ECO     | external crystal oscillator  |
| EEPROM  | electrically erasable programmable read-only memory  |
| EMI     | electromagnetic interference   |
| EMIF    | external memory interface  |
| EOC     | end of conversion  |
| EOF     | end of frame   |
| EPSR    | execution program status register  |
| ESD     | electrostatic discharge  |
| ETM     | embedded trace macrocell   |
| FIR     | finite impulse response, see also IIR  |

Acronyms

**Table 49** Acronyms used in this document (continued)

| Acronym                  | Description  |
|--------------------------|--|
| FPB                      | flash patch and breakpoint                             |
| FS                       | full-speed   |
| GPIO                     | general-purpose input/output, applies to a PSoC™ pin   |
| HVI                      | high-voltage interrupt, see also LVI, LVD              |
| IC                       | integrated circuit                                     |
| IDAC                     | current DAC, see also DAC, VDAC                        |
| IDE                      | integrated development environment                     |
| I <sup>2</sup> C, or IIC | Inter-Integrated Circuit, a communications protocol    |
| IIR                      | infinite impulse response, see also FIR                |
| ILO                      | internal low-speed oscillator, see also IMO            |
| IMO                      | internal main oscillator, see also ILO                 |
| INL                      | integral nonlinearity, see also DNL                    |
| I/O                      | input/output, see also GPIO, DIO, SIO, USBIO           |
| IPOR                     | initial power-on reset                                 |
| IPSR                     | interrupt program status register                      |
| IRQ                      | interrupt request                                      |
| ITM                      | instrumentation trace macrocell                        |
| LCD                      | liquid crystal display                                 |
| LIN                      | Local Interconnect Network, a communications protocol. |
| LR                       | link register  |
| LUT                      | lookup table   |
| LVD                      | low-voltage detect, see also LVI                       |
| LVI                      | low-voltage interrupt, see also HVI                    |
| LVTTL                    | low-voltage transistor-transistor logic                |
| MAC                      | multiply-accumulate                                    |
| MCU                      | microcontroller unit                                   |
| MISO                     | master-in slave-out                                    |
| NC                       | no connect   |
| NMI                      | nonmaskable interrupt                                  |
| NRZ                      | non-return-to-zero                                     |
| NVIC                     | nested vectored interrupt controller                   |
| NVL                      | nonvolatile latch, see also WOL                        |
| opamp                    | operational amplifier                                  |
| PAL                      | programmable array logic, see also PLD                 |
| PC                       | program counter  |
| PCB                      | printed circuit board                                  |
| PGA                      | programmable gain amplifier                            |
| PHUB                     | peripheral hub   |
| PHY                      | physical layer   |
| PICU                     | port interrupt control unit                            |

Acronyms

**Table 49** Acronyms used in this document (continued)

| Acronym | Description  |
|---------|--|
| PLA     | programmable logic array   |
| PLD     | programmable logic device, see also PAL                                |
| PLL     | phase-locked loop  |
| PMDD    | package material declaration data sheet                                |
| POR     | power-on reset   |
| PRES    | precise power-on reset   |
| PRS     | pseudo random sequence   |
| PS      | port read data register  |
| PSoC™   | Programmable system-on-chip  |
| PSRR    | power supply rejection ratio   |
| PWM     | pulse-width modulator  |
| RAM     | random-access memory   |
| RISC    | reduced-instruction-set computing                                      |
| RMS     | root-mean-square   |
| RTC     | real-time clock  |
| RTL     | register transfer language   |
| RTR     | remote transmission request  |
| RX      | receive  |
| SAR     | successive approximation register                                      |
| SC/CT   | switched capacitor/continuous time                                     |
| SCL     | I <sup>2</sup> C serial clock  |
| SDA     | I <sup>2</sup> C serial data   |
| S/H     | sample and hold  |
| SINAD   | signal to noise and distortion ratio                                   |
| SIO     | special input/output, GPIO with advanced features. See GPIO.           |
| SOC     | start of conversion  |
| SOF     | start of frame   |
| SPI     | Serial Peripheral Interface, a communications protocol                 |
| SR      | slew rate  |
| SRAM    | static random access memory  |
| SRES    | software reset   |
| SWD     | serial wire debug, a test protocol                                     |
| SWV     | single-wire viewer   |
| TD      | transaction descriptor, see also DMA                                   |
| THD     | total harmonic distortion  |
| TIA     | transimpedance amplifier   |
| TRM     | technical reference manual   |
| TTL     | transistor-transistor logic  |
| TX      | transmit   |
| UART    | Universal Asynchronous Transmitter Receiver, a communications protocol |

Acronyms

**Table 49** Acronyms used in this document *(continued)*

| <b>Acronym</b> | <b>Description</b>   |
|----------------|--|
| UDB            | universal digital block                                    |
| USB            | Universal Serial Bus                                       |
| USBIO          | USB input/output, PSoC™ pins used to connect to a USB port |
| VDAC           | voltage DAC, see also DAC, IDAC                            |
| WDT            | watchdog timer   |
| WOL            | write once latch, see also NVL                             |
| WRES           | watchdog timer reset                                       |
| XRES           | external reset I/O pin                                     |
| XTAL           | crystal  |

## 8 Document conventions

### 8.1 Units of measure

**Table 50** Units of measure

| Symbol | Unit of measure        |
|--------|------------------------|
| °C     | degrees Celsius        |
| dB     | decibel                |
| fF     | femto farad            |
| Hz     | hertz                  |
| KB     | 1024 bytes             |
| kbps   | kilobits per second    |
| Khr    | kilohour               |
| kHz    | kilohertz              |
| kΩ     | kilo ohm               |
| ksps   | kilosamples per second |
| LSB    | least significant bit  |
| Mbps   | megabits per second    |
| MHz    | megahertz              |
| MΩ     | mega-ohm               |
| MspS   | megasamples per second |
| μA     | microampere            |
| μF     | microfarad             |
| μH     | microhenry             |
| μs     | microsecond            |
| μV     | microvolt              |
| μW     | microwatt              |
| mA     | milliampere            |
| ms     | millisecond            |
| mV     | millivolt              |
| nA     | nanoampere             |
| ns     | nanosecond             |
| nV     | nanovolt               |
| Ω      | ohm                    |
| pF     | picofarad              |
| ppm    | parts per million      |
| ps     | picosecond             |
| s      | second                 |
| sps    | samples per second     |
| sqrtHz | square root of hertz   |
| V      | volt                   |

## Revision history

| Document revision | Date       | Description of changes   |
|-------------------|------------|--|
| *O                | 2023-01-20 | Post to external web.  |
| *P                | 2023-05-02 | Removed 48-pin QFN package related information in all instances across the document.<br>Updated <b>Pinouts</b> :<br>Updated <b>Table 2</b> .<br>Updated <b>Packaging</b> :<br>Updated <b>Table 45</b> .<br>Updated <b>Package diagrams</b> :<br>Removed spec 002-29721 Rev. **.  |
| *Q                | 2023-11-13 | Added 48-pin QFN package related information in all instances across the document.<br>Updated <b>Pinouts</b> :<br>Added <b>Table 1</b> .<br>Updated <b>Alternate pin functions</b> :<br>Updated <b>Table 4</b> .<br>Updated <b>Ordering information</b> :<br>Updated part numbers.<br>Removed Note “Alternate fab available.” and its reference in <b>Table 44</b> .<br>Updated <b>Packaging</b> :<br>Updated <b>Table 45</b> .<br>Updated <b>Package diagrams</b> :<br>Added spec 002-33925 Rev. *A.<br>Updated to new template.<br>Completing Sunset Review. |

**Trademarks**

All referenced product or service names and trademarks are the property of their respective owners.

**Edition 2023-11-13**

**Published by**

**Infineon Technologies AG  
81726 Munich, Germany**

**© 2004 Infineon Technologies AG.  
All Rights Reserved.**

**Do you have a question about this document?**

**Email:**

[erratum@infineon.com](mailto:erratum@infineon.com)

**Document reference**

**002-20072 Rev. \*Q**

**IMPORTANT NOTICE**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.



**WARNINGS**

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

-  [View CY8C4147AZE-S475 on WIN SOURCE](#)
-  [Infineon Technologies Information](#)

## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management