PSoC™ Control C3 - PSC3P5xD, PSC3M5xD

Preliminary datasheet

Arm® Cortex®-M33 32-bit MCU+FPU+DSP, 180 MHz, up to 256 KB Flash/64 KB SRAM, Real-time Control

Features

Green

Halogen-free

Lead-free

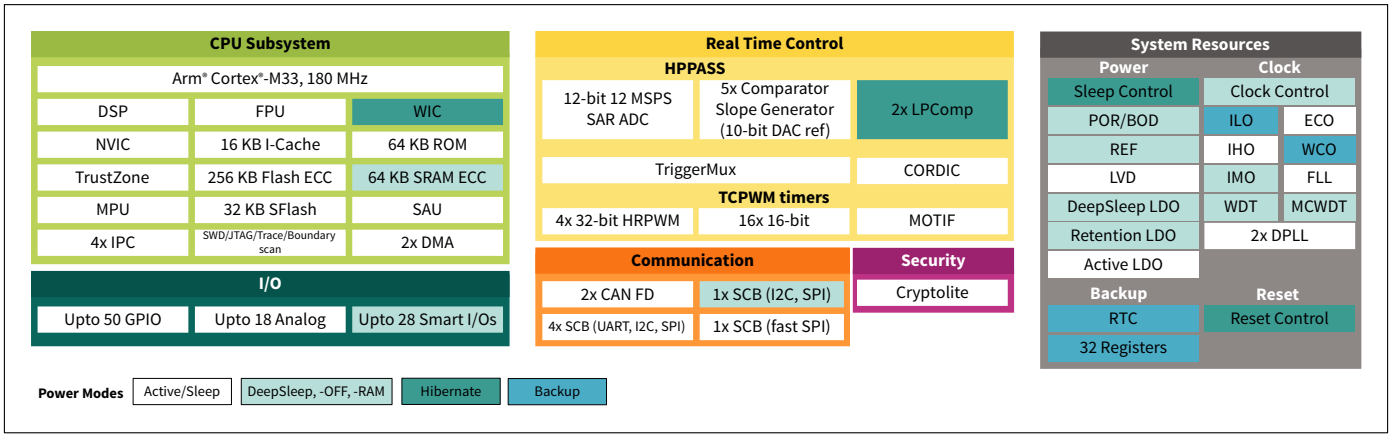
- High-performance, low-power 32-bit single-core Arm® Cortex® M33-based microcontroller with digital signal processor (DSP), floating-point unit (FPU), and state-of-the-art security features
- High-performance, programmable analog subsystem (HPPASS):
  - 12-bit, 12-Msps SAR ADC with parallel idle sampling of up to 16 analog channels
  - Five comparators with <10 ns built-in 10-bit DAC and slope generator
- Real-time control peripherals:
  - Coordinate rotation digital computer (CORDIC)
  - 16 x 16-bit and 4 x 32 bit timer/counter pulse-width modulator (TCPWM) supporting <80 ps high-resolution pulse-width modulator (HRPWM)
- Enhanced routing flexibility with a combinatorial trigger multiplexing unit
- Communication interfaces: Six SCB and two CAN FD (one supporting 8 Mbps)
- 256 KB read-while-write flash with ECC support
- Low-power operation: Sleep, Deep Sleep (three modes) below 10 µA, and Hibernate below 1 µA
- Up to 50 GPIOs with programmable drive modes, strengths, and slew rates; up to 28 pins support Smart I/O programmable logic and up to 16 dedicated analog pins
- Security: PSA L2 certified; configurable flash partitioning and protection
- Safety: Class B and SIL 2 compliant safety test libraries are available
- Power supply range: 1.7 V to 3.6 V
- Ambient temperature range: -40°C to 105°C Ta
- Packages: VQFN-48, E-LQFP-48, VQFN-64, E-LQFP-64, E-LQFP-80

Potential applications

- Motor control in power tools, home appliances, industrial drives, light electric vehicles, robotics, and drones
- Digital power control in switched mode power supply (SMPS) and PFC applications for LED lighting, EV chargers, solar inverters, servers, and PC power supplies
- Wide bandgap technologies (e.g., SiC and GaN) based motor control and power conversion applications

Description

The PSC3P5xD and PSC3M5xD devices are based on the Arm® Cortex®-M33 running up to 180 MHz with DSP and FPU capability. In addition to the CPU subsystem, the devices contain advanced real-time control peripherals, such as high-performance programmable analog subsystem, comparators, advanced timers with high-resolution capability, up to six SCBs and two CAN FDs for communication. The devices support one Active and five low-power modes for managing and reducing the power consumption depending on application requirements.



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1 Introduction

The PSC3P5x and PSC3M5x devices are part of the PSoC™ Control C3 MCU family designed for real-time control, enhanced sensing, secure, and low-power operations. Some target applications for these microcontrollers are:

- Industrial motor-controllers
- Power-stage converters
- Home appliances
- Automation devices
- Low-power sensors

A detailed block diagram of the MCU is shown in Figure 1.

Device identification and revisions

Family ID = 0x118(12-bit); Si ID range = EE40- EE7F; Major-minor rev ID = 0x1, 0x1

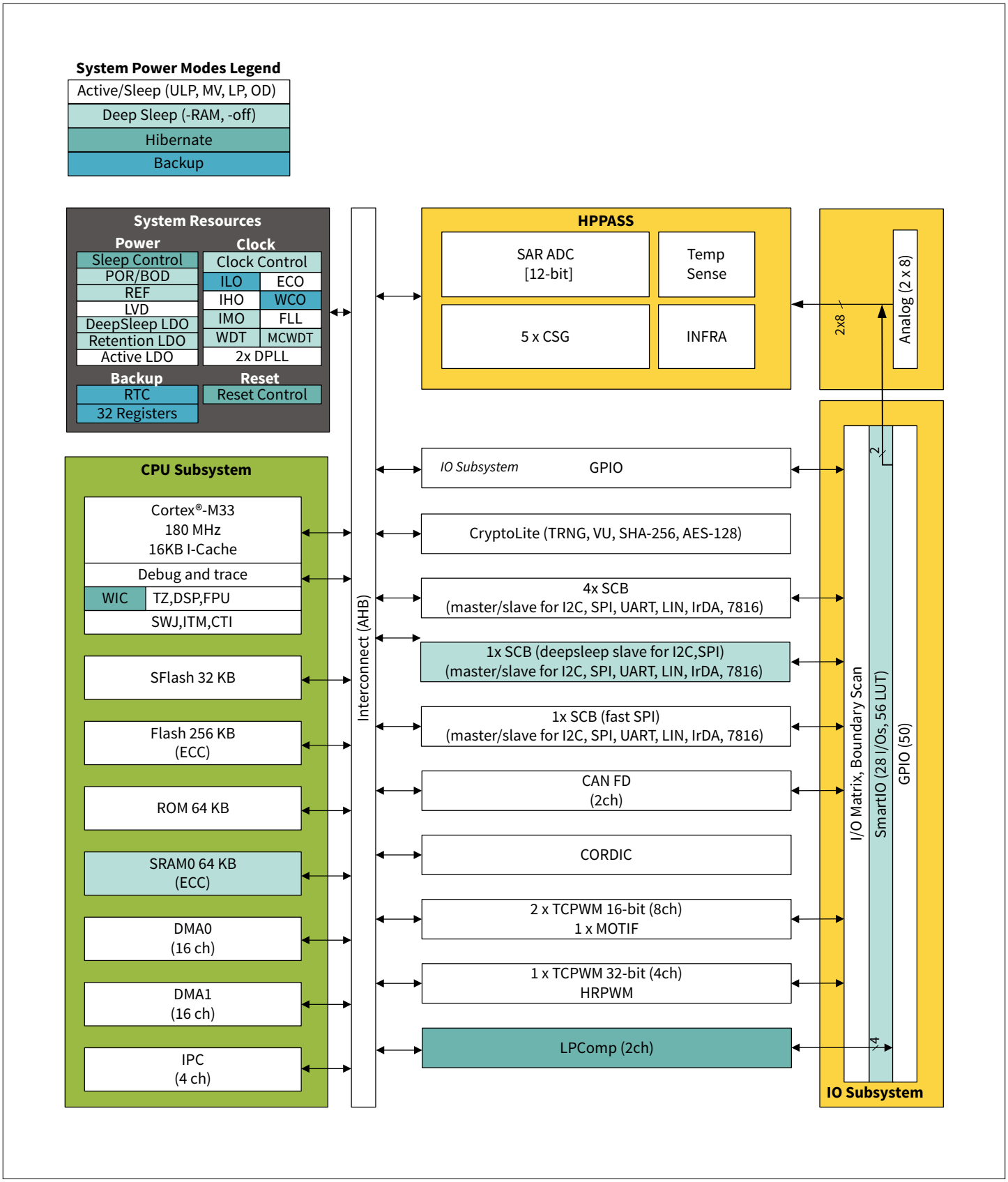


Figure 1 Functional block diagram

2 Detailed features

This device has the following features:

- CPU subsystem
  - Arm® Cortex®-M33 running up to 180 MHz
  - Digital signal processor (DSP), floating-point unit (FPU), memory protection unit (MPU), 16 KB I-cache
  - Two direct memory access (DMA) controllers with 16 channels each
  - Security
    - Platform security architecture level 2 (PSA L2) certified
    - Step-wise authentication of execution images until the control is handed over to the user code
    - Secure execution of code in the execute-only mode for protected routines
    - Image authentication and integrity check
    - TrustZone® framework that establishes an isolated device root-of-trust (RoT) for trust attestation and software management
- Memory
  - On-chip flash with ECC support
    - Up to 256-KB flash with read-while-write (RWW) capability, 64 KB ROM for boot code, and bootloader functions
    - Built-in device firmware upgrade (DFU) support in boot ROM via serial interface (UART/I2C/SPI)
  - SRAM with ECC support
    - 64 KB full SRAM available in Deep Sleep
      - SRAM data path is protected with a hardware mechanism (ECC) for soft error detection and correction
- Clocking subsystem
  - 8 MHz IMO with Deep Sleep operation offering ±2% accuracy
  - 48 MHz internal high-frequency oscillator (IHO) offering ±1% accuracy
  - 4 to 35 MHz external crystal oscillator (ECO) with a Phase-Locked Loop (PLL) for CPU and subsystem clocking
  - 32 kHz external watch crystal oscillator (WCO) usable for Real-Time Clock (RTC)
  - 32 kHz internal low frequency oscillator (ILO) offering ±10% accuracy
- Low power (1.7 V to 3.6 V) operation
  - Six power modes (Active, Sleep, Deep Sleep, Deep Sleep-RAM, Deep Sleep-OFF, and Hibernate) for fine-grained power management
  - Deep Sleep mode current of 11 µA at 3.3-V external supply using an internal voltage regulator with 64-KB SRAM retention, LPComp, and Deep Sleep SCB
  - Hibernate mode current with RTC and LPComp of up to 1000 nA
- Communication peripherals
  - Serial communication blocks (SCBs)
    - Up to six independent run-time-reconfigurable SCBs; each is software-configurable as master or slave for I2C, SPI, or UART
    - One SCB also supports slave operation in Deep Sleep mode and provides wake-up from Deep Sleep on I2C and SPI
    - One SCB has fast SPI support of up to 50 MHz
    - SCB supports single-wire half-duplex mode for UART
  - CAN FD
    - Up to two CAN FD channels with a single instance with operation of up to 8 Mbps

- High-performance, programmable analog subsystem (HPPASS)
  - Analog-to-digital converter (ADC)
    - One 12 bit, 12-Msps SAR ADC
    - Up to 16 dedicated analog pads, connected to up to 16 parallel sample stages
    - Two additional GPIOs can be used as analog inputs
    - Up to 16 sample/hold (S/H) circuits in SAR ADC connected to pins directly or through AMUX
    - One S/H circuit in SAR ADC is internally connected to analog references and a temperature sensor
    - Configurable input gain of 1, 3, 6, and 12 on all 16 S/H circuits
    - Digital comparator at the output to compare the ADC result against programmed boundary values
    - Digital comparator outputs can be connected to timer/counter pulse-width modulator (TCPWM) (low latency between the modules)
  - Analog comparators
    - Five Active comparators without Deep Sleep functionality, each with a 10-bit DAC to generate the comparator reference
    - Each comparator supports an external reference/threshold through pins
    - Active comparator can be used with the in-built DAC in Hysteresis mode
    - Two additional comparators in LPComp are available in Active/Deep Sleep/Hibernate modes
    - Comparator outputs can be brought to pins for control loop applications
    - Comparator outputs can be connected to TCPWM (low latency between the modules)
    - Logical OR of multiple comparator trigger outputs connected as an input trigger to TCPWM via trigger MUX
- Real-time control peripherals
  - Coordinate rotation digital computer (CORDIC)
    - Supports all CORDIC operating modes for solving circular (trigonometric), hyperbolic functions, and integrated independent look-up tables to accelerate calculation
  - Timer/counter pulse-width modulator (TCPWM)
    - Sixteen 16-bit TCPWM channels
    - Four 32-bit TCPWM channels supporting high-resolution PWM generation (HRPWM) for PWM outputs
    - Center-aligned, edge, and pseudorandom modes
    - Comparator-based triggering of kill signals
    - Shadow update of duty, period, dead-time, output signal polarity, and dithering (pseudorandom mode)
    - Multichannel control: In a group of eight TCPWM channels, one channel within a group can trigger another channel
    - Ability to logically combine the outputs of multiple channels through Smart I/O
    - Dedicated output triggers mux in a group to allow flexibility to the PWM channel as a trigger and/or gate signals to the HPPASS
    - Hall sensor interface with autonomous BLDC block commutation support
    - Quadrature encoder interface to decode motor speed and rotor position
    - HRPWM feature for period, duty, and dead-time insertion with a typical resolution of less than 100 ps

- I/O subsystem
  - Programmable GPIO pins
    - Up to 66 functional pins (50 digital GPIOs; 2 out of 50 GPIOs can be used for analog inputs + 16 dedicated analog-only inputs)
    - Programmable drive modes, strengths, and slew rates
  - Programmable digital
    - Up to seven Smart I/O capable ports (28 I/Os, 56 LUTs) enable Boolean operations on I/O signals
- Cryptography
  - Cryptography accelerator
    - Hardware acceleration for symmetric (AES-128) and asymmetric cryptographic algorithms (RSA and ECC (Elliptic Curve Cryptography) supported by vector unit (VU) and hash functions (SHA-256)
    - True random number generator (TRNG) function

3 Chip-level functional description

3.1 Power

The device offers multiple features for managing and reducing power draw. Multiple power modes include Active, Sleep, Deep Sleep, and Hibernate. Deep Sleep has three variations based on retention of SRAM.

The power control block provides assurance that voltage levels meet the requirements of the respective modes. It can:

- Delay mode entry (for example, at power-on reset (POR)) until voltage levels are as required for proper functioning
- Detect operation below safe power supply levels:
  - Generates interrupts for low-voltage detection (LVD)
  - Generates reset for brownout detection (BOD)

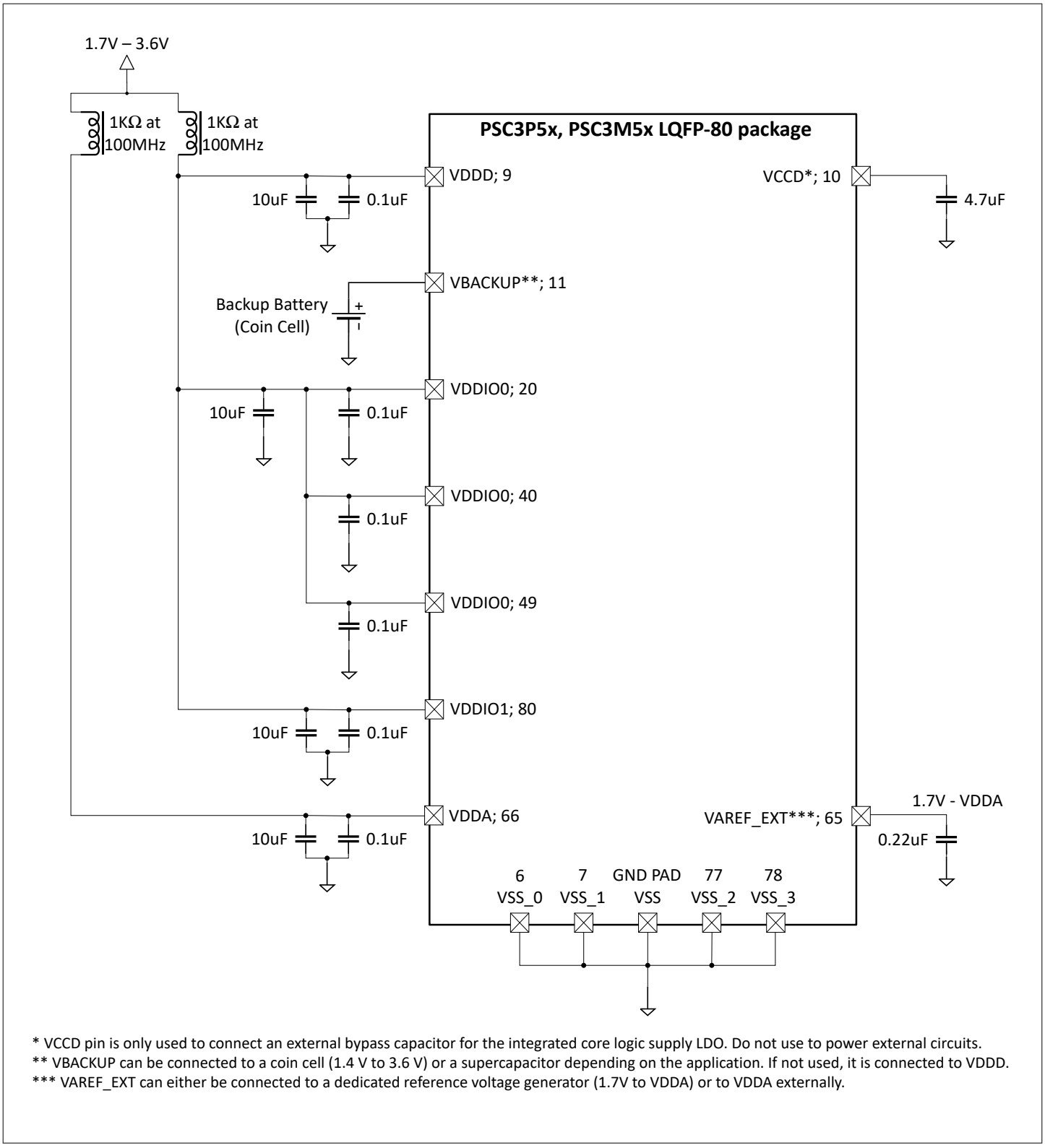
The device operates using a single regulated VDDD supply within the range of 1.7 V to 3.6 V. In addition, there is an optional VBACKUP supply that can be used, which has a range of 1.4 V to 3.6 V. A linear regulator powers the core logic at four voltage levels: 0.9 V, 1.0 V, 1.1 V, and 1.2 V. Voltage level switching is implemented by writing to the power control registers. The voltage for the core logic can be set based on the application's performance and power requirements; (see Power modes). With clock gating at peripheral and bus levels, this permits fine-grained optimization of energy usage.

Typically, the backup domain requires an input voltage of 1.4 V to 3.6 V, which can be provided by connecting a backup battery or a super capacitor to the VBACKUP pin. The internal backup switch automatically selects between VDDD and VBACKUP (when VDDD is no longer available) for powering the backup domain peripherals like RTC, WCO, ILO, and Backup registers. Some I/O cells are powered from the VBACKUP supply before the internal backup switch. If the application does not require a dedicated backup source, VBACKUP can be connected to VDDD externally to ensure that the I/O cells powered by VBACKUP are functional; (see Pins).

3.1.1 Power connections

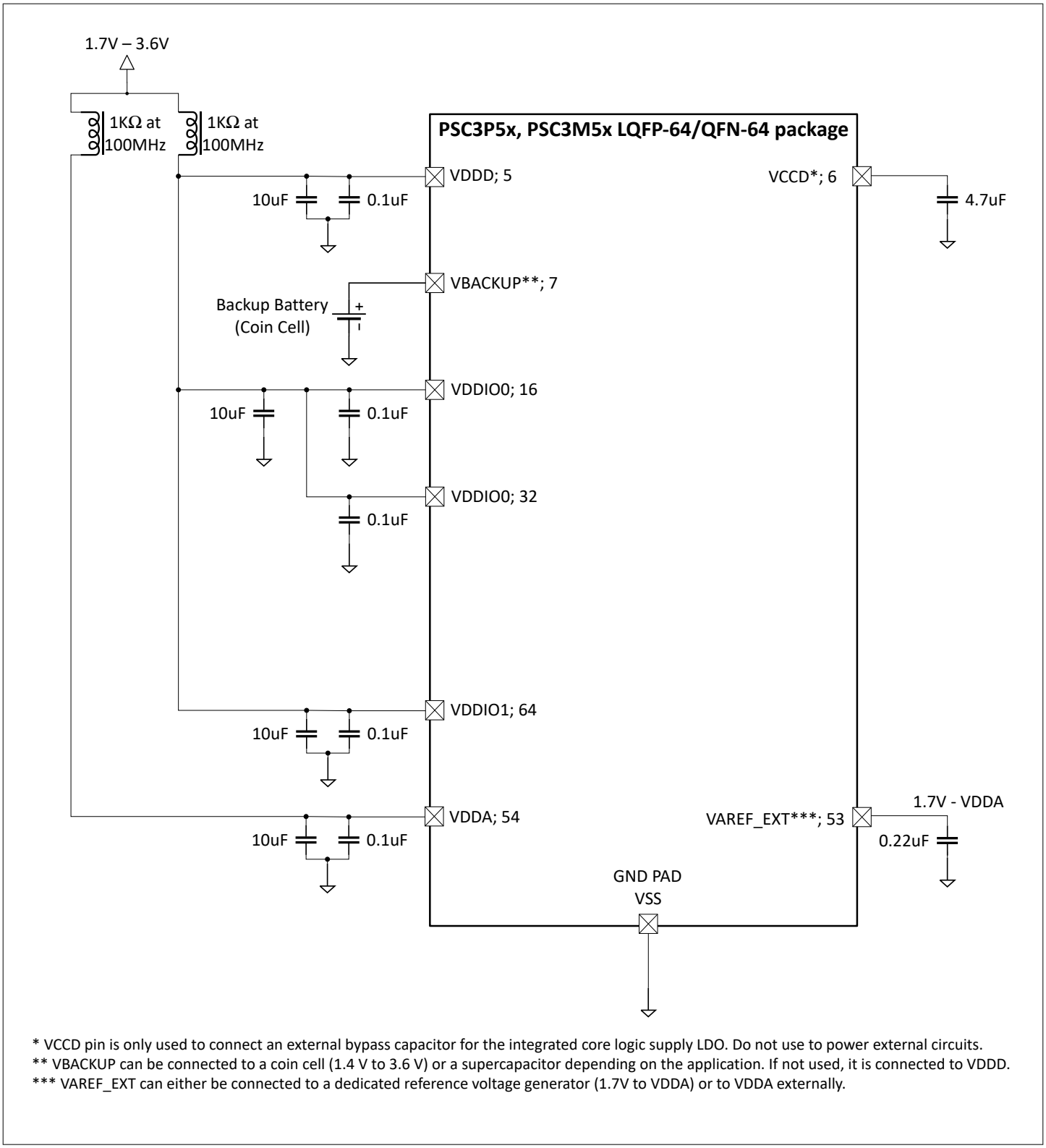
The following power system diagrams show typical connections for the power pins for all the supported packages. In these diagrams, the package pin is shown with the pin name, for example, "VDD; 9".

There is no dependency on power supply sequencing.



* VCCD pin is only used to connect an external bypass capacitor for the integrated core logic supply LDO. Do not use to power external circuits.
** VBACKUP can be connected to a coin cell (1.4 V to 3.6 V) or a supercapacitor depending on the application. If not used, it is connected to VDDD.
*** VAREF_EXT can either be connected to a dedicated reference voltage generator (1.7V to VDDA) or to VDDA externally.

Figure 2 LQFP-80 package power connections



* VCCD pin is only used to connect an external bypass capacitor for the integrated core logic supply LDO. Do not use to power external circuits.
** VBACKUP can be connected to a coin cell (1.4 V to 3.6 V) or a supercapacitor depending on the application. If not used, it is connected to VDDD.
*** VAREF_EXT can either be connected to a dedicated reference voltage generator (1.7V to VDDA) or to VDDA externally.

Figure 3 LQFP-64/QFN-64 package power connection

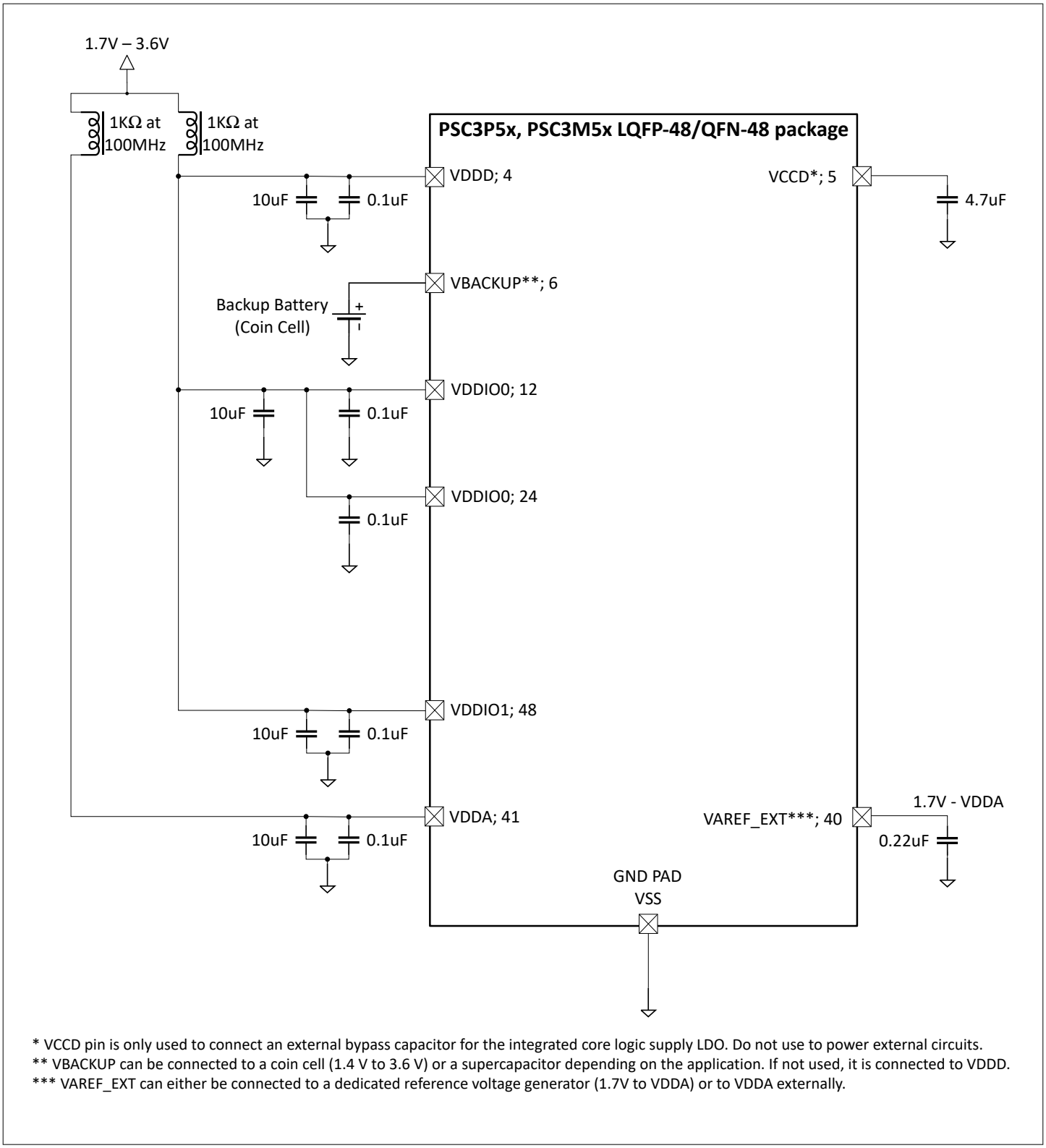
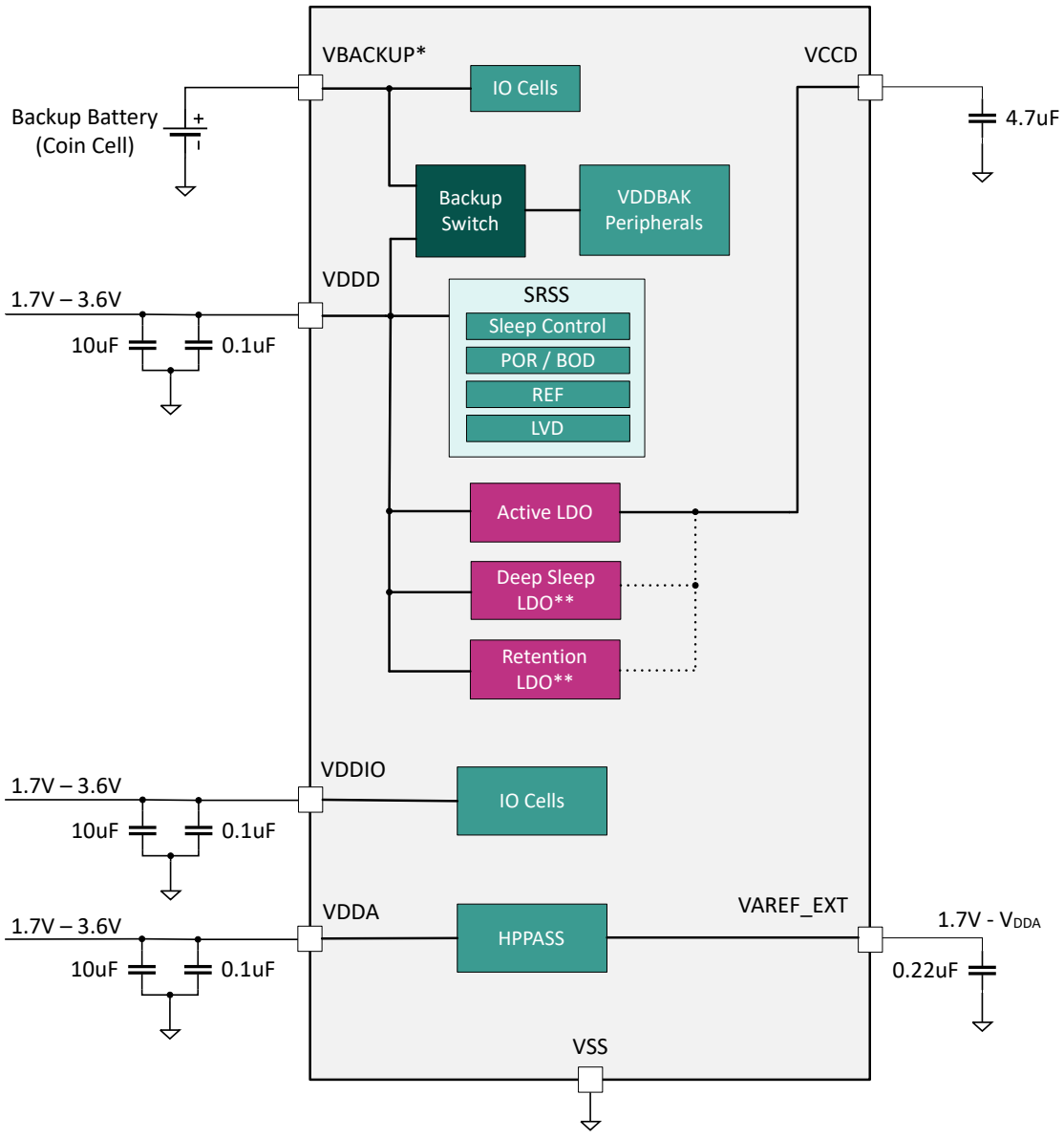


Figure 4 LQFP-48/QFN-48 package power connections

3.1.2 Power domains

The device has independent power domains, allowing the domain power to be enabled/disabled depending on the power mode.

A preliminary diagram of the power connections and routing is shown in Figure 5:



* VBACKUP can be connected to a coin cell (1.4 V to 3.6 V) or a supercapacitor depending on the application. If not used, it is connected to VDDD.
** Depending on the power mode, Deep Sleep LDO / Retention LDO outputs are connected to the VCCD supply line.

Figure 5 Power distribution and domains

3.1.3 Power modes

This product can operate in five power modes. These power modes are intended to minimize the average power consumption in an application.

Power modes supported are:

- **Active/Sleep:** All peripherals are powered. The CPU is either active and executing the code or can be put in sleep (clock gated). Any interrupt can wake up the CPU within one CPU clock cycle to resume operation. In Active

mode, the core voltage can be set to any of the four values. This impacts both power consumption and maximum clock frequency for CPU and peripherals. The following active modes are supported:

- ULP (Ultra Low Power): 0.9 V core voltage with 50 MHz CPU frequency
- MF (Medium Frequency): 1.0 V core voltage with 70 MHz CPU frequency
- LP (Low Power): 1.1 V core voltage with 150 MHz CPU frequency
- OD (Overdrive): 1.2 V core voltage with 180 MHz CPU frequency

- **Deep Sleep:** The CPU is in retention mode. RAM content is also retained. Only Deep Sleep capable peripherals can wake up the system. Once awake, the operation resumes
- **Deep Sleep-RAM:** The CPU is turned off. 64 KB of SRAM is retained for a warm boot after wake-up. Only Deep Sleep-capable peripherals are operational if enabled and are capable of waking up the system
- **Deep Sleep-OFF** Same as Deep Sleep RAM except RAM is also turned off. The wake-up action is reset or cold boot
- **Hibernate:** All peripherals except LPComp and backup domain peripherals such as RTC and HIB are turned off. All clocks except the backup domain clock and all internal regulators are turned off. This results in asynchronous operation of the LPComp. The system is reset when it exits the Hibernate mode

3.1.4 Power mode transitions

The device supports Arm® standard power modes; see the Power modes section for details. Table 1 lists the parameters for supported power modes:

Table 1 Power mode support

	Active/Sleep	Deep Sleep	Deep Sleep-RAM	Deep Sleep-OFF	Hibernate	Off
Parameters						
Wake source[1)]	Any interrupt	DS peripherals	DS peripherals	DS peripherals	RTC/HIB peripherals	Power on
Wake action	Resume	Resume	Warm boot	Reset/cold boot	Reset	Reset
Wake time	One CPU cycle	<20 µs	Deep Sleep + warm boot	Deep Sleep + cold boot	POR + cold boot < 1 ms	
Resources						
ECO	On/Off	On/Off	On/Off	On/Off	Off	Off
IHO	On	Off	Off	Off	Off	Off
IMO	On	On/Off	Off	Off	Off	Off
ILO	On/Off	On/Off	On/Off	On/Off	Off	Off
WCO	On/Off	On/Off	On/Off	On/Off	On/Off	Off
CPU	On/Sleep	Retention	Off	Off	Off	Off
SRAM	On	On	On/Off	Off	Off	Off

1) See Table 2 for the list of peripherals available in DS (Deep Sleep) and HIB (Hibernate) power modes.

3.1.5 Power block support

Table 2 shows the available operational states for the major blocks in this device. Note that the operational states possible in low-power modes are generally limited in functionality and parametric performance as compared to their

capabilities in the Active power mode. Additionally, blocks that do not support low-power modes such as Deep Sleep and Hibernate cannot wake up the CPU from these power modes. See Power modes for details.

Table 2 Block power modes

Block	Power mode				
	Active	**Sleep**	**Deep Sleep**	**Hibernate**	**Backup**
CPUSS					
CPU	Y	N	N	N	N
NVIC	Y	Y	N	N	N
WIC	Y	Y	Y	N	N
FLASH	Y	Y	N	N	N
SRAM	Y	Y	Y	N	N
DMA	Y	Y	N	N	N
Programmable digital					
SMART I/O	Y	Y	Y	N	N
Fixed function digital					
TCPWM	Y	Y	N	N	N
SCB	Y	Y	Y	N	N
CAN FD	Y	Y	N	N	N
Special function					
CORDIC	Y	N	N	N	N
Analog					
HPPASS (SAR, CSG)	Y	Y	N	N	N
LPComp	Y	Y	Y	Y	N
I/O					
GPIO	Y	Y	Y	Y[1)]	N
Backup					
RTC	Y	Y	Y	Y	Y
Registers	Y	Y	Y	Y	Y

1) Only hibernate_wakeup pins (P2.0 and P9.0) are operational and capable of waking up the device from Hibernate mode. For more information, see the Pins section.

3.2 Security

Both secure and nonsecure debug accesses are supported. In nonsecure access, the debugger cannot access the areas marked as “secure”. In the secure case, the device can be “locked” such that it may not be acquired for test or debug.

Certificate management assures that appropriate accesses are provided for secure debug and RMA transition.

This device is fully compliant with Arm® TrustZone® at hardware and software levels. An extra layer of security is implemented with the help of Infineon-proprietary protection units.

PSA L2-certified parts support PSA-compliant cryptographic services, key management, and secure storage services (For PSA L2 parts, see Ordering information).

3.2.1 Security features

- Arm® platform security architecture compliant with PSA level 2 precertification, depending on part number (see Table 24)
- Protected firmware feature support depending on part number (see Table 24)
- Hardware crypto accelerator with comprehensive support of cryptographic algorithms
- Secure isolation of processing environments via Arm® TrustZone®
- Infineon proprietary MPU, MPC, and PPCs for memory and peripheral access control
- Off-the-shelf secure isolation using Trusted Firmware-M (TF-M) and mbedTLS crypto acceleration package

3.2.2 Security architecture overview

Cortex® -M33:

- Arm® TrustZone® enabled core with two processing environments: secure (SPE) and nonsecure (NSPE)
- Infineon proprietary protection units for memory and peripheral protection
- Integrated mbedTLS crypto acceleration package that supports software and hardware cryptography services
- Infineon-provided Trusted firmware-M (TF-M) implemented in SPE — its services are leveraged by Cortex® -M33 NSPE and SPE

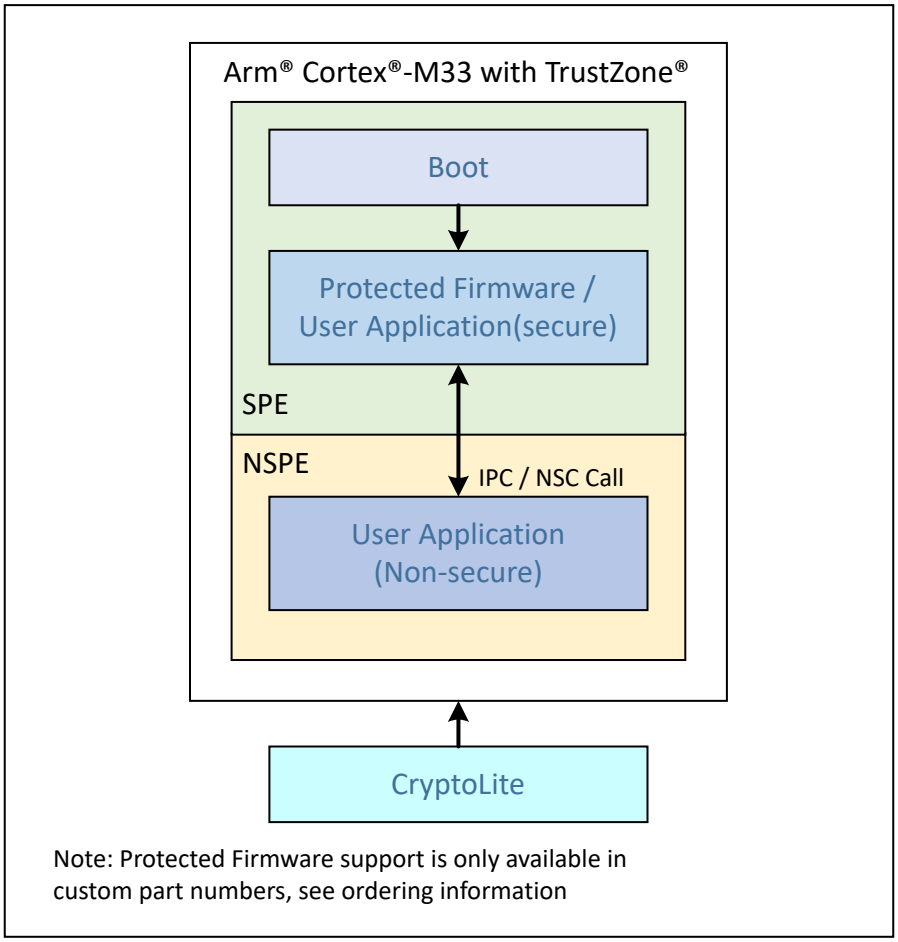


Figure 6 Security architecture diagram

4 Block functional description

4.1 CPU

- Arm® Cortex®-M33 with digital signal processor (DSP)
- Floating-point unit (FPU)
- The TrustZone® framework establishes an isolated device root of trust for trusted attestation and software management
- Memory protection unit (MPU): Supports eight regions each for secure and nonsecure MPUs
- Secure attribution unit (SAU): It defines the security status of up to eight memory regions
- Debug facilities including trace (embedded trace macrocell (ETM), no embedded trace buffer (ETB))
- 16 KB I-cache for flash and ROM access

A separate 4-channel interprocessor communication (IPC) module (two IRQs) offers seamless support for semaphores and mailbox structures within secure and nonsecure execution.

The subsystems include an interrupt controller such as a nested vectored interrupt controller (NVIC). It also consists of a wake-up interrupt controller (WIC), which can wake the processor up from system Deep Sleep mode, allowing the main processor power and clocks to be turned-off when the chip is in system Deep Sleep mode.

The CPU subsystem also includes debug interfaces and supports both SWD and JTAG. The chip also supports boundary scan, which is required for testing on a PCB, and a separate test access port (TAP) controller is provided for controlling boundary scan functions.

4.2 DMA

The Cortex®-M33 CPU includes two DMA controllers that can be used to transfer data to and from memory, and peripheral registers. This allows for autonomous transfer of data from peripherals such as ADC to memory, or allows deterministic control of peripherals such as the PWM.

The DMA controllers are bus masters in their respective domains. Each DMA has 16 channels. It has a single transfer engine for all channels that arbitrates for bus master access. The DMA uses the 32-bit AHB bus that shares the same clock as the CPU.

4.3 Cryptography support (CryptoLite)

One instance of the cryptographic acceleration block that implements hardware support for true random number generator (TRNG), SHA-256, AES-128, and vector unit (VU), is provided.

4.4 Memory

The device features multiple nonvolatile and volatile memory types. The CPU and other bus masters can access any memory block. The number of wait states depends on the access path.

4.4.1 Flash

The device offer up to 256 KB of user-programmable flash. The flash supports single and dual bank modes. Dual bank mode supports the RWW feature, which allows reading from one sector while programming the other. In addition, the flash module has ECC support.

4.4.2 SFlash

The device has 32-KB supervisory flash (SFlash) memory. SFlash stores the device trim settings, secure key hashes, and FLASH_BOOT firmware. Device trim settings are used to initialize hardware resources for proper operation. Secure key hashes are used to authenticate Infineon and OEM assets and images. SFlash cannot be used to store user data.

4.4.3 ROM

All PSoC™ Control C3 devices offer 64 KB of ROM. The ROM contains boot and configuration routines and authentication checks. After a reset event, the boot code in the supervisory ROM (SROM) checks the Reset Cause register to determine whether a Hibernate event was the cause of the reset to provide the fastest possible transition to execute the user code. This minimizes the wake-up time from Hibernate mode as opposed to a power on reset (POR) or an external reset (XRES) event.

4.4.4 RAM

The device has 64 KB SRAM memory, with provision of retaining memory during Deep Sleep power mode. SRAM has ECC support for soft error detection and correction.

4.5 eFuse

The device contains 1024 one-time programmable (OTP) eFuse bits. These are reserved for system use such as device life-cycle management, trim, and hash values. eFuse bits cannot be directly programmed by the user.

Each fuse is individually programmed; once programmed (or “blown”), its state cannot be changed. Blowing a fuse transitions it from the default state of ‘0’ to ‘1’. To program an eFuse, VDDIO0 must be at 2.5 V ±10%.

Because blowing an eFuse is an irreversible process, any process requiring eFuse programming is recommended only in mass production under controlled factory conditions by Infineon provided provisioning tools.

4.6 Clock system

The PSoC™ Control C3 clock system is responsible for providing clocks to all subsystems requiring clocks and switching between different clock sources without glitching. In addition, the clock system ensures that no metastable conditions occur.

Furthermore, a clock supervision (CSV) circuit is implemented for each clk_hf domain. The CSV circuit detects a stopped clock or an abnormal frequency of the monitored clock. There are clock counters for both the monitored clock and the reference clock. Parameters for each counter define the frequency of the reference clock and the upper and lower limit for the frequency of the monitored clock.

If the dedicated frequency range comparator detects a stopped clock or a clock outside the specified frequency range, an abnormal state is signaled. Depending on the register settings and how the monitored clock is used on the device, either a reset or an interrupt is generated.

The following clock sources are provided:

- Internal main oscillator (IMO): 8 MHz ±2%, fast wake-up, low jitter
- Internal high-speed oscillator (IHO): 48 MHz ±1%
- Internal low-speed oscillator (ILO): 32 kHz ±10%, also as a wake-up source for the RTC
- External crystal oscillators (ECO and WCO)
  - External crystal oscillator (ECO): 4 MHz - 35 MHz
  - External watch crystal oscillator (WCO): 32.768 kHz
- External clock (EXTCLK): Maximum frequency 80 MHz

- One frequency lock loop (FLL) with 24 -100 MHz output range
- Two digital phase-locked loops, DPLL#0 and DPLL#1, with 25 - 250 MHz output range

4.6.1 Internal main oscillator (IMO)

Internal main oscillator (IMO) operates at a fixed 8 MHz frequency. Its tolerance is ±2%. A high-speed clock can be derived using the IMO plus a DPLL. It has fast wake-up and low jitter.

4.6.2 Internal high-frequency oscillator (IHO)

Internal high-frequency oscillator (IHO) operates at a fixed 48 MHz frequency. Its tolerance is ±1%. A high speed-clock can be derived using the IHO plus DPLL.

4.6.3 Internal low-frequency oscillator (ILO)

The ILO is a low-power oscillator with a typical current of 0.3 µA and frequency of 32 kHz with ±10% accuracy. The ILO can be used as wake-up source for real-time clock (RTC)

4.6.4 External crystal oscillator (ECO)

External crystal oscillator (ECO) can use a crystal with frequency ranging from 4 MHz to 35 MHz for generating a high-precision clock. This option can be used when the precision offered by internal oscillators is not sufficient.

4.6.5 Watch crystal oscillator (WCO)

WCO uses an external 32.768 kHz crystal for applications requiring higher-precision real-time clock (RTC) functionality. WCO clock can be routed directly to the RTC for higher precision and to avoid any glitches due to internal switching of clock sources.

4.6.6 Watchdog timer (WDT)

One watchdog timer (WDT) and one multi-counter watchdog timer (MCWDT) are provided. The WDT is implemented in the clock block running from the ILO or the WCO. This allows the watchdog operation during Deep Sleep and can generate a watchdog reset if not serviced before the timeout. The watchdog reset is recorded in the Reset Cause register.

4.6.7 Real-time clock (RTC)

The device includes a real-time clock (RTC). The RTC has the following features:

- Can operate in both 12-hour format with AM/PM flag and 24-hour format
- Automatic leap year correction
- The alarm feature allows the RTC to generate an interrupt, which may be used to wake up the system from Sleep, Deep Sleep, and Hibernate power modes

4.7 Reset

The device can be reset from various sources, including a software reset. Reset events are asynchronous and ensure reversion to a known state. The reset cause (WDT, MCWDT, Faults, Debug, Software, and Clock Supervision) is recorded in a register, which is sticky through reset, and allows the software to determine the cause of the reset. An XRES pin is available for external reset.

4.8 High-performance programmable analog subsystem (HPPASS)

4.8.1 12-bit SAR analog-to-digital converter (ADC)

The device has one 12-bit SAR ADC with up to 16 parallel sampling channels. The ADC supports multiple S/H, which enables synchronous sampling on several channels.

All analog channels support individually selectable input gains of 1, 3, 6, and 12. In addition, all channels can be oversampled and averaged in hardware. The SAR ADC supports up to 12-Msps rate for a repeated conversion of the same channel. The ADC can operate with a voltage range between 1.7 V to 3.6 V (VDDA). The AREF_EXT pin is used to provide the ADC reference voltage. It can be connected to a precision reference voltage generator (1.7 V to VDDA) or connected externally to the AVCC pin.

The idle sampling feature allows ADC triggers to start directly from hold operation. All 16 samplers can be triggered simultaneously for simultaneous idle sampling (same hold instance) and sequential conversion (useful for multimotor, multiphase motor control and digital power applications). ADC has a sequencer with eight groups that can be programmed according to the user application. Each group defines a set of inputs that will be simultaneously sampled when that group is triggered by hardware or firmware. Each group supports the control and conversion of up to 16 samplers, and the sample time can be configured for each group. It supports two-level priority conversion. Each group can be configured to high or low-priority conversion.

The ADC has a set of built-in post processing features for the converted digital data such as averaging, pseudo differential mode, 2x FIR with 16 taps, 8x limit detect, 8x channel gain and offset correction coefficients with support for signed or unsigned result format. These features help in reducing CPU utilization for analog data acquisition and post processing.

The ADC can be connected to an internal temperature sensor, the value of which can be read and digitized. This is useful for calibration and other temperature-dependent functions. For more information, see Temperature sensor. The ADC is not available in the Deep Sleep and Hibernate power modes.

4.8.2 Comparator and slope generator (CSG)

The device has five analog comparators that operate in Active mode. The comparator output is synchronized to avoid metastability. The comparator output can be routed to a GPIO or TCPWM (through TriggerMux), for example, as an input to kill the PWM signal if an overvoltage or over current condition is detected.

The five Active mode comparators can use the built-in 10-bit DACs or another analog input to define the programmable threshold for the comparator. The output of the DAC serves as a reference for the comparator. The DAC output is connected to the internal S/H circuit of the ADC through AMUX with other inputs. The ADC can measure the output of the comparator.

The comparator DAC values can be updated by either direct or buffered writes. This can be used for slope generation or LUT waveform generation.

The comparators can also be used in Hysteresis mode. Hysteresis voltage is configurable by the user and the comparator provides a run-time configuration for it.

4.8.3 Temperature sensor

The PSoC™ Control C3 devices contain a diode-based temperature sensor. It can be disabled to save power. The temperature sensor is connected to the SAR ADC through AMUX as one of the measurement channels. The precision of the temperature sensor output is ±5°C over the full operating temperature range.

4.9 Low-power comparator (LPComp)

The device provides two low-power comparators that can operate in all power modes. This allows other analog system resources to be disabled while retaining the ability to monitor external voltage levels during Deep Sleep and Hibernate modes. The comparator outputs are normally synchronized to avoid metastability unless operating in an asynchronous power mode (Hibernate) where the wake-up circuit is activated by a comparator-switch event.

4.10 Fixed function digital

4.10.1 Timer/counter pulse-width modulator (TCPWM)

The TCPWM consists of the following:

- A counter with user-programmable period/duty length PWM outputs
- A capture register to record the count value at the time of an event (which may be an I/O event)
- A period register to either stop or auto reload the counter when its count is equal to the period registers
- Compare registers to generate compare value signals that are used as PWM duty cycle outputs

The block provides accurate and complementary outputs with a programmable offset between them to allow its use as dead-band programmable complementary PWM outputs. It also has a kill input to force the outputs to a predetermined state; this can be used in motor drive and power conversion systems, for example, when an overcurrent state is indicated and the PWMs driving the FETs must be shut off immediately with no time for software intervention.

TCPWM has a Motion Interface (MOTIF) block that can be used in Hall sensor, Quadrature encoder or standalone Multichannel mode.

TCPWM also supports a high-resolution PWM (HRPWM) feature. The 32-bit four-channel TCPWM counters are enhanced with the following functionalities:

- It can program and control the PWM output signals with a typical resolution of less than 100 ps
- It can control the period, duty cycle, and dead-time with the high-resolution function

4.10.2 Serial communication block (SCB)

The PSoC™ Control C3 has up to six SCB modules, which can be software-configured for I2C, UART, or SPI interface as master or slave when in Active mode. One of the SCB modules can operate in Deep Sleep mode with an external clock with the functionality limited to I2C slave or SPI slave. Every protocol can use a 256-byte-deep FIFO per SCB module. All SCB blocks support DMA transfers.

4.10.2.1 Inter-integrated circuit (I2C)

The hardware I2C block implements a full multi-master and multi-slave interface and is capable of multi-master arbitration. This block can operate at speeds of up to 1 Mbps (Fast Mode Plus) and has flexible buffering options to reduce the interrupt overhead and latency for the CPU. It also supports EZI2C, which creates a mailbox address range in the memory of the PSoC™ Control C3. This effectively reduces the I2C communication overheads for reading from and writing to an array in the memory. The FIFO significantly reduces the need for clock stretching caused by the CPU not having read the data on time.

4.10.2.2 Universal asynchronous transmitter receiver (UART)

The full-feature UART can operate at up to 8 Mbps. It supports LIN (automotive single-wire interface), IrDA (Infrared interface), and SmartCard (ISO7816) protocols. In addition, it supports the 9-bit multiprocessor mode, which allows

addressing of peripherals connected over common RX and TX lines. Common UART functions such as hardware flow control, parity, break detection, and frame error are supported. The SCB can be configured in half-duplex UART mode for single-wire communication.

4.10.2.3 Serial peripheral interface (SPI)

The SPI mode supports full Motorola SPI, Texas Instruments synchronous serial port (SSP) (essentially adds a start pulse used to synchronize SPI codecs), and National Semiconductor Microwire (a half-duplex form of SPI). The SPI block also supports an EZ-SPI mode in which data interchange is reduced to reading and writing an array in memory. Fast SPI can support master and slave functionalities up to 50 MHz.

4.10.3 Controller area network flexible data-rate (CAN FD)

CAN FD features two channels including timestamp support and a 4-KB message RAM per channel. This block supports data rates of up to 8 Mbps.

4.11 Trigger multiplexer (TriggerMux)

TriggerMux is used to connect several TCPWM counter channels to achieve multichannel support, where the output from one counter can be used to trigger or execute a function in other channels.

The trigger connections between TCPWM and HPPASS are also connected through the TriggerMux. Configuring any TCPWM counter to trigger any S/H circuit of the ADC inside HPPASS is possible.

The digital comparator outputs from the ADC and analog comparator outputs are also connected to the TCPWM from the HPPASS through the TriggerMux. It is possible to route any digital/analog comparator output to any TCPWM group and any counter inside the group.

The connections between the TCPWM and HPPASS are optimized for low latency.

4.12 Coordinate rotation digital computer (CORDIC)

CORDIC is used to precisely compute the transforms used in motor speed and position estimation as well as reference plane transforms commonly used in Field-Oriented Control (FOC). It calculates trigonometric functions in hardware to offload the processing from the main CPU. Supported algorithms include sine, cosine, arctan, sinh, cosh, arctanh, phase, sqrt, and park transform.

4.13 General-purpose input/output (GPIO) ports

The PSoC™ Control C3 provides up to 50 GPIO pads with two pad-power-supply domains. Two of the GPIOs are multiplexed with analog inputs, making it possible to have a maximum of 18 analog input connections. The GPIO block has the following features:

- Eight drive modes including strong push-pull, resistive pull-up and pull-down, weak (resistive) pull-up and pull-down, open-drain and open-source, input-only, and disabled
- Analog signal input capability (I/O buffers disabled; signal passed through switches)
- Input threshold select (CMOS or LVTTL)
- Individual control of input and output disables
- Hold mode for latching the previous state (used for retaining the I/O state in Deep Sleep and Hibernate modes)
- Selectable slew rates for dV/dt-related noise control

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

Data Output and Pin State registers store the values to be driven on the pins and the pins' states.

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.

The I/O ports will retain their state during Hibernate mode. If the operation is restored using Reset, then the pins will go to the High-Z state; if the operation is restored by using the wake-up pin, the pin drivers will retain their previously frozen state until the firmware chooses to change it.

Simultaneous output switching in high-current mode requires attention to line termination and decoupling capacitor size to control switching transient voltages.

4.14 Smart I/O (Programmable I/O)

Each smart I/O block contains eight programmable LUT arrays out of which up to six LUT arrays are associated with a particular I/O port that allows integration of board-level glue logic and Boolean functions at the pins. The remaining free LUT arrays can be connected to the I/O LUT array outputs for creating more complex logic functions. It is similar to programmable array logic (PAL) or small programmable logic devices (PLDs). The smart I/O block is interposed between the port pins and the HSIOM (responsible for multiplexing signals from on-chip peripherals to and from the port pins) and the digital signal interconnect (DSI) signals. It is possible to bypass the smart I/O block in order not to impact the propagation delay for critical paths from the DSI to the port pins.

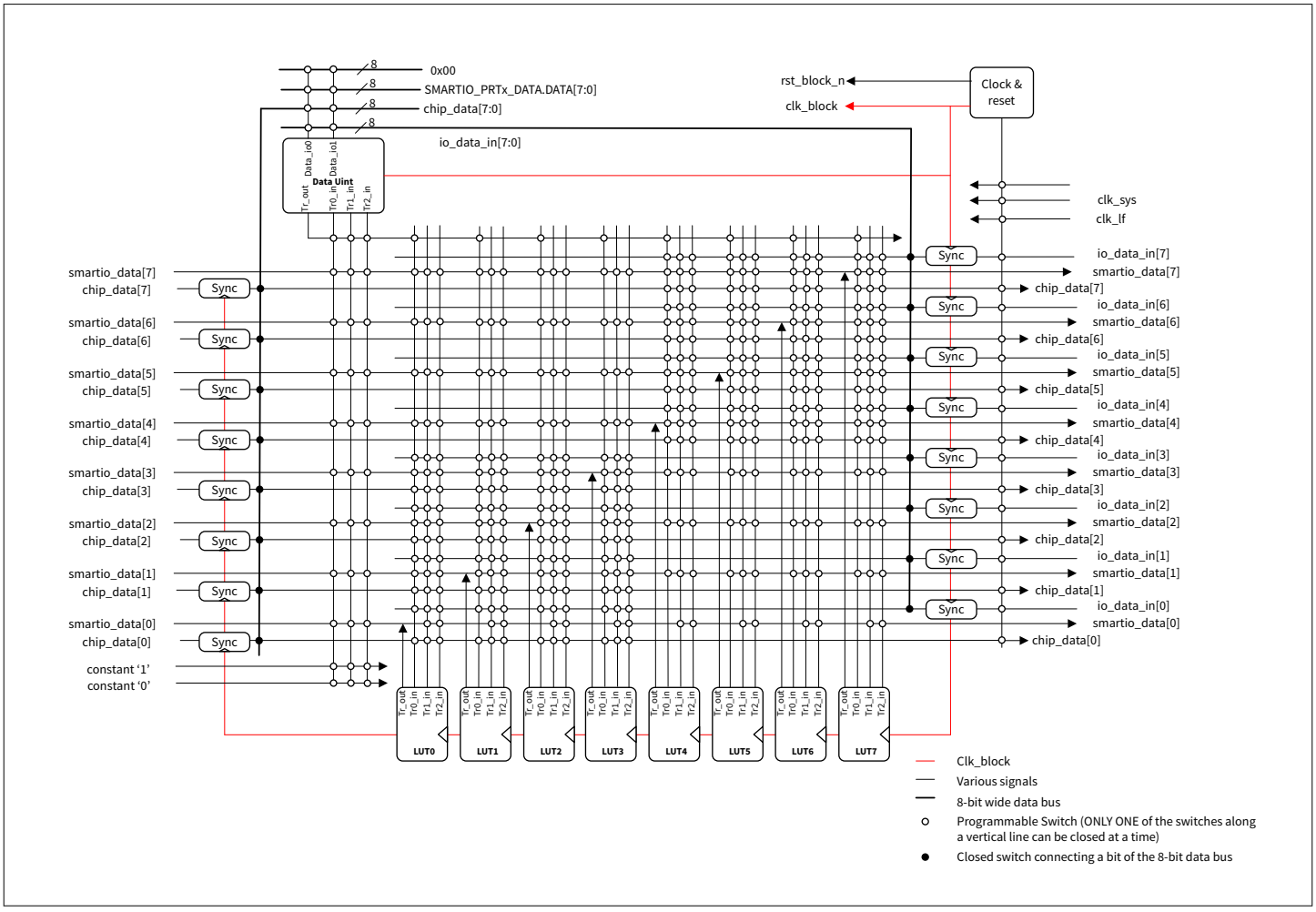


Figure 7 Smart I/O block diagram

The structure is interposed between the GPIO port and the HSIOM.

5 Pins

GPIO ports are powered by VDDx pins as follows:

- P0: VBACKUP
- P1, P2, P3, P4, P5, P6, P7: VDDIO0
- P8, P9: VDDIO1
- AN_A, AN_B: AVDD

  The number of GPIOs is limited in some packages. The E-LQFP-80 package has the full 50 GPIOs and 16 analog inputs; the E-LQFP-64/VQNF-64 package has 39 GPIOs and 16 analog inputs; the E-LQFP-48/VQFN-48 package has 29 GPIOs and 10 analog inputs. For detailed information on the supported packages, see Package information section

Table 3 Packages and pin information

Pin	Packages		
	E-LQFP-80	E-LQFP-64/VQFN-64	E-LQFP-48/VQFN-48
VDDD	9	5	4
VDDA	66	54	41
VDDIO_0_0	20	16	12
VDDIO_0_1	40	32	24
VDDIO_0_2	49	-	-
VDDIO_1	80	64	48
VCCD	10	6	5
VSS	GND PAD	GND PAD	GND PAD
VSS_0	6	-	-
VSS_1	7	-	-
VSS_2	77	-	-
VSS_3	78	-	-
VAREF_EXT	65	53	40
VBACKUP	11	7	6
AN_A0	53	41	31
AN_A1	54	42	32
AN_A2	55	43	33
AN_A3	56	44	34
AN_A4	57	45	35
AN_A5	58	46	36
AN_A6	59	47	-
AN_A7	60	48	-
AN_B0	61	49	-
AN_B1	62	50	37
AN_B2	63	51	38
AN_B3	64	52	39
AN_B4	67	55	42

(table continues...)

Table 3 (continued) Packages and pin information

Pin	Packages		
	E-LQFP-80	E-LQFP-64/VQFN-64	E-LQFP-48/VQFN-48
AN_B5	68	56	-
AN_B6	69	57	-
AN_B7	70	58	-
XRES	8	4	3
P0.0	12	8	7
P0.1	13	9	-
P1.0	14	10	-
P1.1	15	11	-
P1.2	16	12	8
P1.3	17	13	9
P2.0	18	14	10
P2.1	19	15	11
P2.2	21	17	13
P2.3	22	18	14
P3.0	23	-	-
P3.1	24	-	-
P3.2	25	-	-
P3.3	26	-	-
P4.0	27	19	15
P4.1	28	20	16
P4.2	29	21	17
P4.3	30	22	18
P4.4	31	23	19
P4.5	32	24	20
P4.6	33	25	21
P4.7	34	26	22
P5.0	35	27	-
P5.1	36	28	-
P5.2	37	29	-
P5.3	38	30	-
P6.0	39	31	23
P6.1	41	33	25
P6.2	42	34	26
P6.3	43	35	27
P7.0	44	36	28

(table continues...)

Table 3 (continued) Packages and pin information

Pin	Packages		
	E-LQFP-80	E-LQFP-64/VQFN-64	E-LQFP-48/VQFN-48
P7.1	45	37	29
P7.2	46	38	30
P7.3	47	39	-
P7.4	48	40	-
P7.5	50	-	-
P7.6	51	-	-
P7.7	52	-	-
P8.0	71	59	43
P8.1	72	60	44
P8.2	73	61	45
P8.3	74	62	46
P8.4	75	-	-
P8.5	76	-	-
P9.0	79	63	47
P9.1	1	1	-
P9.2	2	2	1
P9.3	3	3	2
P9.4	4	-	-
P9.5	5	-	-

6 GPIO alternate functions tables

Table 4 GPIO alternate functions and HSIOM routes

GPIO	Alternate functions and HSIOM routes			
P0.0	wco_out	fixed	smartio.io0	fixed
	ext_clk	ACT #8	peri.tr_io_input[0]:0	ACT #14
	peri.tr_io_output[0]:0	ACT #15		
P0.1	wco_in	fixed	smartio.io1	fixed
	peri.tr_io_input[1]:0	ACT #14	peri.tr_io_output[1]:0	ACT #15
P1.0	eco_in	fixed	smartio.io0	fixed
	peri.tr_io_output[58]:1	ACT #1	peri.tr_io_output[70]:1	ACT #2
	scb1.uart.cts	ACT #4	scb1.spi.select0	ACT #6
	peri.tr_io_input[2]:0	ACT #14	peri.tr_io_output[2]:0	ACT #15

(table continues...)

Table 4 (continued) GPIO alternate functions and HSIOM routes

GPIO	Alternate functions and HSIOM routes			
P1.1	eco_out	fixed	smartio.io1	fixed
	peri.tr_io_output[59]:1	ACT #1	peri.tr_io_output[71]:1	ACT #2
	scb1.uart.rts	ACT #4	scb1.spi.clk	ACT #6
	peri.tr_io_input[3]:0	ACT #14	peri.tr_io_output[3]:0	ACT #15
P1.2	smartio.io2	fixed	peri.tr_io_output[60]:1	ACT #1
	peri.tr_io_output[72]:1	ACT #2	scb1.uart.rx	ACT #4
	scb1.spi.mosi	ACT #6	scb1.i2c.sda	ACT #7
	peri.tr_io_input[4]:0	ACT #14	peri.tr_io_output[4]:0	ACT #15
	swj.swclk/tclk	DS #5		
P1.3	smartio.io3	fixed	peri.tr_io_output[61]:1	ACT #1
	peri.tr_io_output[73]:1	ACT #2	scb1.uart.tx	ACT #4
	scb1.spi.miso	ACT #6	scb1.i2c.scl	ACT #7
	peri.tr_io_input[5]:0	ACT #14	peri.tr_io_output[5]:0	ACT #15
	swj.swdio/tms	DS #5		
P2.0	hibernate_wakeup	fixed	smartio.io0	fixed
	peri.tr_io_output[58]:0	ACT #1	tcpwm0.g2.cnt6+	ACT #2
	scb1.uart.cts	ACT #4	scb1.spi.select0	ACT #6
	peri.tr_io_input[6]:0	ACT #14	peri.tr_io_output[6]:0	ACT #15
	swj.swdoe/tdi	DS #5		
P2.1	smartio.io1	fixed	peri.tr_io_output[59]:0	ACT #1
	tcpwm0.g2.cnt6-	ACT #2	cal_wave	DS #0
	scb1.uart.rts	ACT #4	scb1.spi.clk	ACT #6
	scb1.i2c.scl	ACT #7	peri.tr_io_input[7]:0	ACT #14
	peri.tr_io_output[7]:0	ACT #15	swj.swo/tdo	DS #5
P2.2	smartio.io2	fixed	peri.tr_io_output[60]:0	ACT #1
	tcpwm0.g2.cnt7+	ACT #2	scb1.uart.rx	ACT #4
	scb1.spi.mosi	ACT #6	scb1.i2c.sda	ACT #7
	ext_clk	ACT #8	peri.tr_io_input[8]:0	ACT #14
	peri.tr_io_output[8]:0	ACT #15		
P2.3	smartio.io3	fixed	peri.tr_io_output[61]:0	ACT #1
	tcpwm0.g2.cnt7-	ACT #2	scb1.uart.tx	ACT #4
	scb1.spi.miso	ACT #6	peri.tr_io_input[9]:0	ACT #14
	peri.tr_io_output[9]:0	ACT #15		

(table continues...)

Table 4 (continued) GPIO alternate functions and HSIOM routes

GPIO	Alternate functions and HSIOM routes			
P3.0	smartio.io0	fixed	peri.tr_io_output[62]:0	ACT #1
	scb4.uart.cts	ACT #4	scb4.spi.mosi	ACT #6
	peri.tr_io_input[10]:0	ACT #14	peri.tr_io_output[10]:0	ACT #15
P3.1	smartio.io1	fixed	peri.tr_io_output[63]:0	ACT #1
	scb4.uart.rts	ACT #4	scb4.spi.miso	ACT #6
	scb4.i2c.sda	ACT #7	peri.tr_io_input[11]:0	ACT #14
	peri.tr_io_output[11]:0	ACT #15		
P3.2	smartio.io2	fixed	peri.tr_io_output[64]:0	ACT #1
	scb4.uart.rx	ACT #4	scb4.spi.clk	ACT #6
	scb4.i2c.scl	ACT #7	peri.tr_io_input[12]:0	ACT #14
	peri.tr_io_output[12]:0	ACT #15		
P3.3	smartio.io3	fixed	peri.tr_io_output[65]:0	ACT #1
	scb4.uart.tx	ACT #4	scb4.spi.select0	ACT #6
	peri.tr_io_input[13]:0	ACT #14	peri.tr_io_output[13]:0	ACT #15
P4.0	peri.tr_io_output[50]:0	ACT #0	tcpwm0.g1.cnt4+	ACT #1
	scb4.uart.cts	ACT #4	scb4.spi.mosi	ACT #6
	peri.tr_io_input[14]:0	ACT #14	peri.tr_io_output[14]:0	ACT #15
P4.1	peri.tr_io_output[51]:0	ACT #0	tcpwm0.g1.cnt4-	ACT #1
	scb4.uart.rts	ACT #4	scb4.spi.miso	ACT #6
	scb4.i2c.sda	ACT #7	peri.tr_io_input[15]:0	ACT #14
	peri.tr_io_output[15]:0	ACT #15		
P4.2	peri.tr_io_output[52]:0	ACT #0	tcpwm0.g1.cnt5+	ACT #1
	scb4.uart.rx	ACT #4	scb4.spi.clk	ACT #6
	scb4.i2c.scl	ACT #7	peri.tr_io_input[16]:0	ACT #14
	peri.tr_io_output[16]:0	ACT #15		
P4.3	peri.tr_io_output[53]:0	ACT #0	tcpwm0.g1.cnt5-	ACT #1
	scb4.uart.tx	ACT #4	scb4.spi.select0	ACT #6
	peri.tr_io_input[17]:0	ACT #14	peri.tr_io_output[17]:0	ACT #15
P4.4	peri.tr_io_output[54]:0	ACT #0	tcpwm0.g1.cnt6+	ACT #1
	peri.tr_io_input[18]:0	ACT #14	peri.tr_io_output[18]:0	ACT #15
P4.5	peri.tr_io_output[55]:0	ACT #0	tcpwm0.g1.cnt6-	ACT #1
	peri.tr_io_input[19]:0	ACT #14	peri.tr_io_output[19]:0	ACT #15

(table continues...)

Table 4 (continued) GPIO alternate functions and HSIOM routes

GPIO	Alternate functions and HSIOM routes			
P4.6	peri.tr_io_output[56]:0	ACT #0	tcpwm0.g1.cnt7+	ACT #1
	peri.tr_io_input[20]:0	ACT #14	peri.tr_io_output[20]:0	ACT #15
P4.7	peri.tr_io_output[57]:0	ACT #0	tcpwm0.g1.cnt7-	ACT #1
	peri.tr_io_input[21]:0	ACT #14	peri.tr_io_output[21]:0	ACT #15
P5.0	smartio.io0	fixed	peri.tr_io_output[62]:1	ACT #1
	scb3.uart.cts	ACT #4	scb3.spi.mosi	ACT #6
	scb3.i2c.sda	ACT #7	peri.tr_io_input[22]:0	ACT #14
	peri.tr_io_output[22]:0	ACT #15		
P5.1	smartio.io1	fixed	peri.tr_io_output[63]:1	ACT #1
	scb3.uart.rts	ACT #4	scb3.spi.miso	ACT #6
	scb3.i2c.scl	ACT #7	peri.tr_io_input[23]:0	ACT #14
	peri.tr_io_output[23]:0	ACT #15		
P5.2	smartio.io2	fixed	peri.tr_io_output[64]:1	ACT #1
	can1.rx	ACT #3	scb3.uart.rx	ACT #4
	scb3.spi.clk	ACT #6	peri.tr_io_input[24]:0	ACT #14
	peri.tr_io_output[24]:0	ACT #15		
P5.3	smartio.io3	fixed	peri.tr_io_output[65]:1	ACT #1
	can1.tx	ACT #3	scb3.uart.tx	ACT #4
	scb3.spi.select0	ACT #6	peri.tr_io_input[25]:0	ACT #14
	peri.tr_io_output[25]:0	ACT #15		
P6.0	smartio.io0	fixed	tcpwm0.g1.cnt4+	ACT #1
	peri.tr_io_output[66]:0	ACT #2	scb3.uart.cts	ACT #4
	scb3.spi.mosi	ACT #6	scb3.i2c.sda	ACT #7
	peri.tr_io_input[26]:0	ACT #14	peri.tr_io_output[26]:0	ACT #15
P6.1	smartio.io1	fixed	tcpwm0.g1.cnt4-	ACT #1
	peri.tr_io_output[67]:0	ACT #2	scb3.uart.rts	ACT #4
	scb3.spi.miso	ACT #6	scb3.i2c.scl	ACT #7
	peri.tr_io_input[27]:0	ACT #14	peri.tr_io_output[27]:0	ACT #15
P6.2	smartio.io2	fixed	tcpwm0.g1.cnt5+	ACT #1
	peri.tr_io_output[68]:0	ACT #2	can1.rx	ACT #3
	scb3.uart.rx	ACT #4	scb3.spi.clk	ACT #6
	peri.tr_io_input[28]:0	ACT #14	peri.tr_io_output[28]:0	ACT #15

(table continues...)

Table 4 (continued) GPIO alternate functions and HSIOM routes

GPIO	Alternate functions and HSIOM routes			
P6.3	smartio.io3	fixed	tcpwm0.g1.cnt5-	ACT #1
	peri.tr_io_output[69]:0	ACT #2	can1.tx	ACT #3
	scb3.uart.tx	ACT #4	scb3.spi.select0	ACT #6
	cpuss.fault[0]:1	ACT #9	peri.tr_io_input[29]:0	ACT #14
	peri.tr_io_output[29]:0	ACT #15		
P7.0	peri.tr_io_output[50]:1	ACT #0	tcpwm0.g1.cnt6+	ACT #1
	peri.tr_io_output[70]:0	ACT #2	scb2.uart.cts	ACT #4
	scb2.spi.clk	ACT #5	scb2.i2c.scl	ACT #7
	trace.data0	ACT #9	hppass.gpio_out0	ACT #12
	peri.tr_io_input[30]:0	ACT #14	peri.tr_io_output[30]:0	ACT #15
P7.1	peri.tr_io_output[51]:1	ACT #0	tcpwm0.g1.cnt6-	ACT #1
	peri.tr_io_output[71]:0	ACT #2	scb2.uart.tx	ACT #4
	scb2.spi.mosi	ACT #5	scb2.i2c.sda	ACT #7
	trace.data1	ACT #9	hppass.gpio_out1	ACT #12
	peri.tr_io_input[31]:0	ACT #14	peri.tr_io_output[31]:0	ACT #15
P7.2	peri.tr_io_output[52]:1	ACT #0	tcpwm0.g1.cnt7+	ACT #1
	peri.tr_io_output[72]:0	ACT #2	scb2.uart.rx	ACT #4
	scb2.spi.miso	ACT #5	trace.data2	ACT #9
	hppass.gpio_out2	ACT #12	peri.tr_io_input[32]:0	ACT #14
	peri.tr_io_output[32]:0	ACT #15		
P7.3	peri.tr_io_output[53]:1	ACT #0	tcpwm0.g1.cnt7-	ACT #1
	peri.tr_io_output[73]:0	ACT #2	scb2.uart.rts	ACT #4
	scb2.spi.select0	ACT #5	trace.data3	ACT #9
	hppass.gpio_out3	ACT #12	peri.tr_io_input[33]:0	ACT #14
	peri.tr_io_output[33]:0	ACT #15		
P7.4	peri.tr_io_output[54]:1	ACT #0	scb2.spi.select1	ACT #5
	trace.clock	ACT #9	hppass.gpio_out4	ACT #12
	peri.tr_io_input[34]:0	ACT #14	peri.tr_io_output[34]:0	ACT #15
P7.5	peri.tr_io_output[55]:1	ACT #0	scb2.spi.select2	ACT #5
	peri.tr_io_input[35]:0	ACT #14	peri.tr_io_output[35]:0	ACT #15
P7.6	peri.tr_io_output[56]:1	ACT #0	peri.tr_io_input[36]:0	ACT #14
	peri.tr_io_output[36]:0	ACT #15		

(table continues...)

Table 4 (continued) GPIO alternate functions and HSIOM routes

GPIO	Alternate functions and HSIOM routes			
P7.7	peri.tr_io_output[57]:1	ACT #0	peri.tr_io_input[37]:0	ACT #14
	peri.tr_io_output[37]:0	ACT #15		
P8.0	lpcomp0.in+	fixed	hppass.gpio_00_aio	fixed
	peri.tr_io_output[62]:2	ACT #1	tcpwm0.g2.cnt4+	ACT #2
	scb5.uart.cts	ACT #4	scb5.spi.select0	ACT #5
	trace.data0	ACT #9	hppass.gpio_out0	ACT #12
	peri.tr_io_input[38]:0	ACT #14	peri.tr_io_output[38]:0	ACT #15
	swj.trstn	DS #5		
P8.1	lpcomp0.in-	fixed	peri.tr_io_output[63]:2	ACT #1
	tcpwm0.g2.cnt4-	ACT #2	scb5.uart.rx	ACT #4
	scb5.spi.mosi	ACT #5	scb5.i2c.scl	ACT #7
	trace.data1	ACT #9	hppass.gpio_out1	ACT #12
	peri.tr_io_input[39]:0	ACT #14	peri.tr_io_output[39]:0	ACT #15
P8.2	lpcomp1.in+	fixed	hppass.gpio_01_aio	fixed
	peri.tr_io_output[64]:2	ACT #1	tcpwm0.g2.cnt5+	ACT #2
	can0.rx	ACT #3	scb5.uart.rts	ACT #4
	scb5.spi.miso	ACT #5	trace.data2	ACT #9
	hppass.gpio_out2	ACT #12	peri.tr_io_input[40]:0	ACT #14
	peri.tr_io_output[40]:0	ACT #15		
P8.3	lpcomp1.in-	fixed	peri.tr_io_output[65]:2	ACT #1
	tcpwm0.g2.cnt5-	ACT #2	can0.tx	ACT #3
	scb5.uart.tx	ACT #4	scb5.spi.clk	ACT #5
	scb5.i2c.sda	ACT #7	trace.data3	ACT #9
	hppass.gpio_out3	ACT #12	peri.tr_io_input[41]:0	ACT #14
	peri.tr_io_output[41]:0	ACT #15		
P8.4	scb5.spi.select1	ACT #5	peri.tr_io_input[42]:0	ACT #14
	peri.tr_io_output[42]:0	ACT #15		
P8.5	scb5.spi.select2	ACT #5	peri.tr_io_input[43]:0	ACT #14
	peri.tr_io_output[43]:0	ACT #15		
P9.0	hibernate_wakeup	fixed	smartio.io0	fixed
	tcpwm0.g2.cnt6+	ACT #2	scb0.spi.clk	DS #1
	scb0.uart.cts	DS #2	scb0.i2c.scl	DS #3
	peri.tr_io_input[44]:0	ACT #14	peri.tr_io_output[44]:0	ACT #15

(table continues...)

Table 4 (continued) GPIO alternate functions and HSIOM routes

GPIO	Alternate functions and HSIOM routes			
P9.1	smartio.io1	fixed	tcpwm0.g2.cnt6-	ACT #2
	scb0.spi.select0	DS #1	scb0.uart.rts	DS #2
	peri.tr_io_input[45]:0	ACT #14	peri.tr_io_output[45]:0	ACT #15
P9.2	smartio.io2	fixed	tcpwm0.g2.cnt7+	ACT #2
	can0.rx	ACT #3	scb0.spi.mosi	DS #1
	scb0.uart.rx	DS #2	scb0.i2c.sda	DS #3
	trace.clock	ACT #9	hppass.gpio_out4	ACT #12
	peri.tr_io_input[46]:0	ACT #14	peri.tr_io_output[46]:0	ACT #15
P9.3	smartio.io3	fixed	tcpwm0.g2.cnt7-	ACT #2
	can0.tx	ACT #3	scb0.spi.miso	DS #1
	scb0.uart.tx	DS #2	cpuss.clk_fm_pump	ACT #8
	cpuss.fault[0]:0	ACT #9	peri.tr_io_input[47]:0	ACT #14
	peri.tr_io_output[47]:0	ACT #15		
P9.4	smartio.io4	fixed	scb0.spi.select1	DS #1
	peri.tr_io_input[48]:0	ACT #14	peri.tr_io_output[48]:0	ACT #15
P9.5	vext_ref_reg	fixed	smartio.io5	fixed
	scb0.spi.select2	DS #1	peri.tr_io_input[49]:0	ACT #14
	peri.tr_io_output[49]:0	ACT #15		

Table 5 GPIO alternate functions

Function	GPIOs	Function	GPIOs	Function	GPIOs
cal_wave	P2.1	can0.rx	P8.2, P9.2	can0.tx	P8.3, P9.3
can1.rx	P5.2, P6.2	can1.tx	P5.3, P6.3	cpuss.clk_fm_pump	P9.3
cpuss.fault[0]:0	P9.3	cpuss.fault[0]:1	P6.3	eco_in	P1.0
eco_out	P1.1	ext_clk	P0.0, P2.2	hibernate_wakeup	P2.0, P9.0
hppass.gpio_00_aio	P8.0	hppass.gpio_01_aio	P8.2	hppass.gpio_out0	P7.0, P8.0
hppass.gpio_out1	P7.1, P8.1	hppass.gpio_out2	P7.2, P8.2	hppass.gpio_out3	P7.3, P8.3
hppass.gpio_out4	P7.4, P9.2	lpcomp0.in+	P8.0	lpcomp0.in-	P8.1
lpcomp1.in+	P8.2	lpcomp1.in-	P8.3	peri.tr_io_input[0]:0	P0.0
peri.tr_io_input[10]:0	P3.0	peri.tr_io_input[11]:0	P3.1	peri.tr_io_input[12]:0	P3.2

(table continues...)

Table 5 (continued) GPIO alternate functions

Function	GPIOs	Function	GPIOs	Function	GPIOs
peri.tr_io_input[13]:0	P3.3	peri.tr_io_input[14]:0	P4.0	peri.tr_io_input[15]:0	P4.1
peri.tr_io_input[16]:0	P4.2	peri.tr_io_input[17]:0	P4.3	peri.tr_io_input[18]:0	P4.4
peri.tr_io_input[19]:0	P4.5	peri.tr_io_input[1]:0	P0.1	peri.tr_io_input[20]:0	P4.6
peri.tr_io_input[21]:0	P4.7	peri.tr_io_input[22]:0	P5.0	peri.tr_io_input[23]:0	P5.1
peri.tr_io_input[24]:0	P5.2	peri.tr_io_input[25]:0	P5.3	peri.tr_io_input[26]:0	P6.0
peri.tr_io_input[27]:0	P6.1	peri.tr_io_input[28]:0	P6.2	peri.tr_io_input[29]:0	P6.3
peri.tr_io_input[2]:0	P1.0	peri.tr_io_input[30]:0	P7.0	peri.tr_io_input[31]:0	P7.1
peri.tr_io_input[32]:0	P7.2	peri.tr_io_input[33]:0	P7.3	peri.tr_io_input[34]:0	P7.4
peri.tr_io_input[35]:0	P7.5	peri.tr_io_input[36]:0	P7.6	peri.tr_io_input[37]:0	P7.7
peri.tr_io_input[38]:0	P8.0	peri.tr_io_input[39]:0	P8.1	peri.tr_io_input[3]:0	P1.1
peri.tr_io_input[40]:0	P8.2	peri.tr_io_input[41]:0	P8.3	peri.tr_io_input[42]:0	P8.4
peri.tr_io_input[43]:0	P8.5	peri.tr_io_input[44]:0	P9.0	peri.tr_io_input[45]:0	P9.1
peri.tr_io_input[46]:0	P9.2	peri.tr_io_input[47]:0	P9.3	peri.tr_io_input[48]:0	P9.4
peri.tr_io_input[49]:0	P9.5	peri.tr_io_input[4]:0	P1.2	peri.tr_io_input[5]:0	P1.3
peri.tr_io_input[6]:0	P2.0	peri.tr_io_input[7]:0	P2.1	peri.tr_io_input[8]:0	P2.2
peri.tr_io_input[9]:0	P2.3	peri.tr_io_output[0]:0	P0.0	peri.tr_io_output[10]:0	P3.0
peri.tr_io_output[11]:0	P3.1	peri.tr_io_output[12]:0	P3.2	peri.tr_io_output[13]:0	P3.3
peri.tr_io_output[14]:0	P4.0	peri.tr_io_output[15]:0	P4.1	peri.tr_io_output[16]:0	P4.2
peri.tr_io_output[17]:0	P4.3	peri.tr_io_output[18]:0	P4.4	peri.tr_io_output[19]:0	P4.5

(table continues...)

Table 5 (continued) GPIO alternate functions

Function	GPIOs	Function	GPIOs	Function	GPIOs
peri.tr_io_output[1]:0	P0.1	peri.tr_io_output[20]:0	P4.6	peri.tr_io_output[21]:0	P4.7
peri.tr_io_output[22]:0	P5.0	peri.tr_io_output[23]:0	P5.1	peri.tr_io_output[24]:0	P5.2
peri.tr_io_output[25]:0	P5.3	peri.tr_io_output[26]:0	P6.0	peri.tr_io_output[27]:0	P6.1
peri.tr_io_output[28]:0	P6.2	peri.tr_io_output[29]:0	P6.3	peri.tr_io_output[2]:0	P1.0
peri.tr_io_output[30]:0	P7.0	peri.tr_io_output[31]:0	P7.1	peri.tr_io_output[32]:0	P7.2
peri.tr_io_output[33]:0	P7.3	peri.tr_io_output[34]:0	P7.4	peri.tr_io_output[35]:0	P7.5
peri.tr_io_output[36]:0	P7.6	peri.tr_io_output[37]:0	P7.7	peri.tr_io_output[38]:0	P8.0
peri.tr_io_output[39]:0	P8.1	peri.tr_io_output[3]:0	P1.1	peri.tr_io_output[40]:0	P8.2
peri.tr_io_output[41]:0	P8.3	peri.tr_io_output[42]:0	P8.4	peri.tr_io_output[43]:0	P8.5
peri.tr_io_output[44]:0	P9.0	peri.tr_io_output[45]:0	P9.1	peri.tr_io_output[46]:0	P9.2
peri.tr_io_output[47]:0	P9.3	peri.tr_io_output[48]:0	P9.4	peri.tr_io_output[49]:0	P9.5
peri.tr_io_output[4]:0	P1.2	peri.tr_io_output[50]:0	P4.0	peri.tr_io_output[50]:1	P7.0
peri.tr_io_output[51]:0	P4.1	peri.tr_io_output[51]:1	P7.1	peri.tr_io_output[52]:0	P4.2
peri.tr_io_output[52]:1	P7.2	peri.tr_io_output[53]:0	P4.3	peri.tr_io_output[53]:1	P7.3
peri.tr_io_output[54]:0	P4.4	peri.tr_io_output[54]:1	P7.4	peri.tr_io_output[55]:0	P4.5
peri.tr_io_output[55]:1	P7.5	peri.tr_io_output[56]:0	P4.6	peri.tr_io_output[56]:1	P7.6
peri.tr_io_output[57]:0	P4.7	peri.tr_io_output[57]:1	P7.7	peri.tr_io_output[58]:0	P2.0
peri.tr_io_output[58]:1	P1.0	peri.tr_io_output[59]:0	P2.1	peri.tr_io_output[59]:1	P1.1
peri.tr_io_output[5]:0	P1.3	peri.tr_io_output[60]:0	P2.2	peri.tr_io_output[60]:1	P1.2

(table continues...)

Table 5 (continued) GPIO alternate functions

Function	GPIOs	Function	GPIOs	Function	GPIOs
peri.tr_io_output[61]:0	P2.3	peri.tr_io_output[61]:1	P1.3	peri.tr_io_output[62]:0	P3.0
peri.tr_io_output[62]:1	P5.0	peri.tr_io_output[62]:2	P8.0	peri.tr_io_output[63]:0	P3.1
peri.tr_io_output[63]:1	P5.1	peri.tr_io_output[63]:2	P8.1	peri.tr_io_output[64]:0	P3.2
peri.tr_io_output[64]:1	P5.2	peri.tr_io_output[64]:2	P8.2	peri.tr_io_output[65]:0	P3.3
peri.tr_io_output[65]:1	P5.3	peri.tr_io_output[65]:2	P8.3	peri.tr_io_output[66]:0	P6.0
peri.tr_io_output[67]:0	P6.1	peri.tr_io_output[68]:0	P6.2	peri.tr_io_output[69]:0	P6.3
peri.tr_io_output[6]:0	P2.0	peri.tr_io_output[70]:0	P7.0	peri.tr_io_output[70]:1	P1.0
peri.tr_io_output[71]:0	P7.1	peri.tr_io_output[71]:1	P1.1	peri.tr_io_output[72]:0	P7.2
peri.tr_io_output[72]:1	P1.2	peri.tr_io_output[73]:0	P7.3	peri.tr_io_output[73]:1	P1.3
peri.tr_io_output[7]:0	P2.1	peri.tr_io_output[8]:0	P2.2	peri.tr_io_output[9]:0	P2.3
scb0.i2c.scl	P9.0	scb0.i2c.sda	P9.2	scb0.spi.clk	P9.0
scb0.spi.miso	P9.3	scb0.spi.mosi	P9.2	scb0.spi.select0	P9.1
scb0.spi.select1	P9.4	scb0.spi.select2	P9.5	scb0.uart.cts	P9.0
scb0.uart.rts	P9.1	scb0.uart.rx	P9.2	scb0.uart.tx	P9.3
scb1.i2c.scl	P1.3, P2.1	scb1.i2c.sda	P1.2, P2.2	scb1.spi.clk	P1.1, P2.1
scb1.spi.miso	P1.3, P2.3	scb1.spi.mosi	P1.2, P2.2	scb1.spi.select0	P1.0, P2.0
scb1.uart.cts	P1.0, P2.0	scb1.uart.rts	P1.1, P2.1	scb1.uart.rx	P1.2, P2.2
scb1.uart.tx	P1.3, P2.3	scb2.i2c.scl	P7.0	scb2.i2c.sda	P7.1
scb2.spi.clk	P7.0	scb2.spi.miso	P7.2	scb2.spi.mosi	P7.1
scb2.spi.select0	P7.3	scb2.spi.select1	P7.4	scb2.spi.select2	P7.5
scb2.uart.cts	P7.0	scb2.uart.rts	P7.3	scb2.uart.rx	P7.2
scb2.uart.tx	P7.1	scb3.i2c.scl	P5.1, P6.1	scb3.i2c.sda	P5.0, P6.0
scb3.spi.clk	P5.2, P6.2	scb3.spi.miso	P5.1, P6.1	scb3.spi.mosi	P5.0, P6.0
scb3.spi.select0	P5.3, P6.3	scb3.uart.cts	P5.0, P6.0	scb3.uart.rts	P5.1, P6.1
scb3.uart.rx	P5.2, P6.2	scb3.uart.tx	P5.3, P6.3	scb4.i2c.scl	P3.2, P4.2
scb4.i2c.sda	P3.1, P4.1	scb4.spi.clk	P3.2, P4.2	scb4.spi.miso	P3.1, P4.1

(table continues...)

Table 5 (continued) GPIO alternate functions

Function	GPIOs	Function	GPIOs	Function	GPIOs
scb4.spi.mosi	P3.0, P4.0	scb4.spi.select0	P3.3, P4.3	scb4.uart.cts	P3.0, P4.0
scb4.uart.rts	P3.1, P4.1	scb4.uart.rx	P3.2, P4.2	scb4.uart.tx	P3.3, P4.3
scb5.i2c.scl	P8.1	scb5.i2c.sda	P8.3	scb5.spi.clk	P8.3
scb5.spi.miso	P8.2	scb5.spi.mosi	P8.1	scb5.spi.select0	P8.0
scb5.spi.select1	P8.4	scb5.spi.select2	P8.5	scb5.uart.cts	P8.0
scb5.uart.rts	P8.2	scb5.uart.rx	P8.1	scb5.uart.tx	P8.3
smartio.io0	P0.0, P1.0, P2.0, P3.0, P5.0, P6.0, P9.0	smartio.io1	P0.1, P1.1, P2.1, P3.1, P5.1, P6.1, P9.1	smartio.io2	P1.2, P2.2, P3.2, P5.2, P6.2, P9.2
smartio.io3	P1.3, P2.3, P3.3, P5.3, P6.3, P9.3	smartio.io4	P9.4	smartio.io5	P9.5
swj.swclk/tclk	P1.2	swj.swdio/tms	P1.3	swj.swdoe/tdi	P2.0
swj.swo/tdo	P2.1	swj.trstn	P8.0	tcpwm0.g1.cnt4+	P4.0, P6.0
tcpwm0.g1.cnt4-	P4.1, P6.1	tcpwm0.g1.cnt5+	P4.2, P6.2	tcpwm0.g1.cnt5-	P4.3, P6.3
tcpwm0.g1.cnt6+	P4.4, P7.0	tcpwm0.g1.cnt6-	P4.5, P7.1	tcpwm0.g1.cnt7+	P4.6, P7.2
tcpwm0.g1.cnt7-	P4.7, P7.3	tcpwm0.g2.cnt4+	P8.0	tcpwm0.g2.cnt4-	P8.1
tcpwm0.g2.cnt5+	P8.2	tcpwm0.g2.cnt5-	P8.3	tcpwm0.g2.cnt6+	P2.0, P9.0
tcpwm0.g2.cnt6-	P2.1, P9.1	tcpwm0.g2.cnt7+	P2.2, P9.2	tcpwm0.g2.cnt7-	P2.3, P9.3
trace.clock	P7.4, P9.2	trace.data0	P7.0, P8.0	trace.data1	P7.1, P8.1
trace.data2	P7.2, P8.2	trace.data3	P7.3, P8.3	vext_ref_reg	P9.5
wco_in	P0.1	wco_out	P0.0	-	-

7 Electrical specifications

***Note**: All electrical specifications are tentative values derived from simulation results. Final specification values will be updated after device characterization.*

7.1 Absolute maximum ratings

Table 6 Absolute maximum ratings

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID1	Analog or Digital Supply relative to VSS (VSSD=VSSA)	VDD_ABS	-0.5	-	4	V	Absolute Maximum
SID2	Direct digital core voltage input relative to Vssd	VCCD_ABS	-0.5	-	1.2	V	Absolute Maximum
SID3	GPIO voltage ; VDDD or VDDA	VGPIO_ABS	-0.5	-	VDD+0.5	V	Absolute Maximum
SID4	Current per GPIO	IGPIO_ABS	-25	-	25	mA	Absolute Maximum
SID5	GPIO injection current per pin	IGPIO_injection	-0.5	-	0.5	mA	Absolute Maximum
SID3A	Electrostatic discharge Human Body Model	ESD_HBM	2200	-	-	V	Absolute Maximum
SID4A	Electrostatic discharge Charged Device Model	ESD_CDM	500	-	-	V	Absolute Maximum
SID5A	Pin current for latchup free operation	LU	-100	-	100	mA	Absolute Maximum
SIDWA8	Maximum undershoot voltage for I/O	Vundershoot	-	-	-0.5	V	Duration not to exceed 25% of the duty cycle
SIDWA9	Maximum overshoot voltage for I/O	Vovershoot	-	-	VDDIO + 0.5	V	Duration not to exceed 25% of the duty cycle
SIDWA10	Maximum junction temperature	Tj	-	-	125	°C	

7.2 Device level specifications

7.2.1 Power supplies

Table 7 Power supplies

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
DC specifications							
SID6	Internal Regulator	VDDD	1.7	-	3.6	V	
SID7B	GPIO Supply for Ports 1, 2, 3, 4, 5, 6, 7	VDDIO_0	1.7	-	3.6	V	
SID7EP	E-Fuse Programming time	EFUSETIME	-	-	5.5	µs	Switch on time of 0.5 µs included
SID7C	GPIO Supply for Ports 8 and 9	VDDIO_1	1.7	-	3.6	V	
SID7A	Analog power supply for ADC and Comparator	VDDA	1.7	-	3.6	V	
SID6B	Backup Power; normally shorted to VDDD (supply PORT 0)	VBACKUP	1.7	-	3.6	V	Min. is 1.4 V in Backup mode
SID8	Output voltage (for core logic bypass)	VCCD (OD)	-	1.2	-	V	Over drive mode
SID8A	Output voltage (for core logic bypass)	VCCD (LP)	-	1.1	-	V	High-speed mode
SID8B	Output voltage (for core logic bypass)	VCCD (ULP)	-	0.9	-		ULP mode. Valid for -20°C to 125°C.
SID10	External Regulator voltage (VCCD) bypass	CEFC	3.8	4.7	5.6	µF	X5R ceramic or better. Value for 0.8 10 1.2 V.
SID11	Power supply decoupling capacitor	CEXC	-	10	-	µF	X5R ceramic or better
Deep Sleep mode							
SIDDS1	With internal LDO enabled and 64K SRAM retention	IDD33A	-	7	11	µA	Max value is at 80°C (not including analog leakage on VDDA and VAREF_EXT)
SIDDS1_B	With internal LDO enabled and 64K SRAM retention	IDD33A_B	-	7	11	µA	Max value is at 60°C (not including analog leakage on VDDA and VAREF_EXT)
SIDDS2	Leakage on analog supply and analog reference in deep sleep mode	IDDA	-	0.1	1.5	µA	Max value is at 85°C

(table continues...)

Table 7 (continued) Power supplies

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Hibernate mode							
SIDHIB1	VDDD = 1.8V	IDD34	-	300	-	nA	No clocks running (not including analog leakage on VDDA and VAREF_EXT)
SIDHIB2	VDDD = 3.3V	IDD34A	-	500	-	nA	No clocks running (not including analog leakage on VDDA and VAREF_EXT)
SIDHIB3	VDDD = 1.8V	IDD35	-	800	-	nA	WCO is running, lpcomp active (not including analog leakage on VDDA and VAREF_EXT)
SIDHIB4	VDDD = 3.3V	IDD35A	-	1000	-	nA	WCO is running, lpcomp active (not including analog leakage on VDDA and VAREF_EXT)
SIDHIB5	Leakage on analog supply and analog reference in hibernate mode	IDDA	-	100	1500	nA	Max value is at 85°C

7.2.2 CPU currents and transition times

Table 8 CPU current and transition times

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Cortex® M33. Active mode							
SIDC2	Execute from Cache;CM33 Active 180 MHz. PLL. Dhrystone. OD mode	IDD4	-	8	9.9	mA	VDDD = 3.3 V, Max at 125°C
SIDC2A	Execute from Cache;CM33 Active 180 MHz. PLL. Dhrystone. OD mode	IDD4A	-	8	9.9	mA	VDDD = 1.8 V, Max at 125°C
SIDC3	Execute from Cache;CM33 Active 150 MHz. PLL. Dhrystone. LP Mode	IDD5	-	5.5	6.75	mA	VDDD = 3.3 V, Max at 125°C
SIDC3A	Execute from Cache;CM33 Active 150 MHz. PLL. Dhrystone. LP Mode	IDD5A	-	5.5	6.75	mA	VDDD = 1.8 V, Max at 125°C

(table continues...)

Table 8 (continued) CPU current and transition times

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SIDC4	Execute from Cache;CM33 Active 70 MHz. PLL. Dhrystone. MF Mode	IDD6	-	2.4	3	mA	VDDD = 3.3 V, Max at 125°C
SIDC4A	Execute from Cache;CM33 Active 70 MHz. PLL. Dhrystone. MF Mode	IDD6A	-	2.4	3	mA	VDDD = 1.8 V, Max at 125°C
SIDC5	Execute from Cache;CM33 Active 50 MHz. PLL. Dhrystone. ULP Mode	IDD7	-	2	2.5	mA	VDDD = 3.3 V, Max at 125°C
SIDC5A	Execute from Cache;CM33 Active 50 MHz. PLL. Dhrystone. ULP Mode	IDD7A	-	2	2.5	mA	VDDD = 1.8 V, Max at 125°C
Cortex® M33 Sleep mode							
SIDS1	CM33 Sleep 180 MHz. PLL., OD Mode	IDD11	-	2.4	3	mA	VDDD = 3.3 V, Max at 105°C
SIDS1A	CM33 Sleep 180 MHz. PLL., OD Mode	IDD11A	-	2.4	3	mA	VDDD = 1.8 V, Max at 105°C
SIDS2	CM33 Sleep 150 MHz. PLL., LP Mode	IDD12	-	2	2.5	mA	VDDD = 3.3 V, Max at 105°C
SIDS2A	CM33 Sleep 150 MHz. PLL., LP Mode	IDD12A	-	2	2.5	mA	VDDD = 1.8 V, Max at 105°C
SIDS3	CM33 Sleep 70 MHz. PLL., MF Mode	IDD13	-	1.6	2	mA	VDDD = 3.3 V, Max at 105°C
SIDS3A	CM33 Sleep 70 MHz. PLL., MF Mode	IDD13A	-	1.6	2	mA	VDDD = 1.8 V, Max at 105°C
SIDS4	CM33 Sleep 50 MHz. PLL., ULP Mode	IDD14	-	1.4	1.8	mA	VDDD = 3.3 V, Max at 105°C
SIDS4A	CM33 Sleep 50 MHz. PLL., ULP Mode	IDD14A	-	1.4	1.8	mA	VDDD = 1.8 V, Max at 105°C
Boot time							
SIDBT1	Boot time after reset	BTIME	-	-	3000000	cycles	Refer to CPU clock cycles
Power mode transition times							
SID13A	Deep Sleep to Active transition time.	TDS_ACT	-	-	45	µs	DS to Active with 1.1 V operation, with upper inrush current limit
SID13B	Deep Sleep to Active LP transition time	TDS_ACTLP	-	-	20	µs	DS to Active LP with 1.0 V operation

(table continues...)

Table 8 (continued) CPU current and transition times

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID13C	Deep Sleep-RAM to Active transition time	TDSR_ACT	-	-	800	µs	DS to Active with 1.1 V operation, with upper inrush current limit
SID13D	Deep Sleep-RAM to Active LP transition time	TDSR_ACTULP	-	-	800	µs	DS-RAM to Active LP with 1.0 V operation
SID14	Hibernate to Active transition time	THIB_ACT	-	2000	-	µS	Including PLL lock time

7.2.3 XRES

Table 9 XRES

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
XRES AC specifications							
SID15	POR or XRES release to Active transition time	TXRES_ACT	-	750	-	µS	
SID16	XRES Pulse width	TXRES_PW	5	-	-	µS	
XRES DC specifications							
SID17	IDD when XRES asserted	TXRES_IDD	-	300	-	nA	VDDD = 1.8 V
SID17A	IDD when XRES asserted	TXRES_IDD_1	-	800	-	nA	VDDD = 3.3 V
SID77	Input Voltage high threshold	VIH	0.7*VDD	-	-	V	CMOS Input
SID78	Input Voltage low threshold	VIL	-	-	0.3*VDD	V	CMOS Input
SID80	Input Capacitance	CIN	-	3	-	pF	XRES resistor removed
SID81	Input voltage hysteresis	VHYSXRES	-	100	-	mV	
SID82	Current through protection diode to VDD/Vss	IDIODE	-	-	100	µA	

7.2.4 GPIO

Table 10 GPIO

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
GPIO DC specifications							
SID57	Input Voltage high threshold	VIH	0.7×VDD	-	-	V	CMOS Input
SID57A	Input current when Pad > VDDIO for OVT inputs	Iihs	-	-	10	µA	per I2C Spec

(table continues...)

Table 10 (continued) GPIO

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID58	Input Voltage low threshold	VIL	-	-	0.3×VDD	V	CMOS Input
SID243	LVTTL input, VDD ≥ 2.7 V	VIH	2	-	-	V	
SID244	LVTTL input, VDD ≥ 2.7 V	VIL	-	-	0.8	V	
SID59	Output Voltage high level	VOH	VDD-0.5	-	-	V	Ioh = 6 mA
SID62A	Output Voltage low level	VOL	-	-	0.4	V	Iol = 6 mA
SID63	Pull-up resistor	RPULLUP	3.5	5.6	8.5	kΩ	
SID64	Pull-down resistor	RPULLDOWN	3.5	5.6	8.5	kΩ	
SID65	Input leakage current(absolute value)	IIL	-	-	2	nA	25°C, VDD = 3.0 V
SID66	Input Capacitance	CIN	-	-	5	pF	
SID67	Input hysteresis LVTTL VDD > 2.7V	VHYSTTL	100	0	-	mV	
SID68	Input hysteresis CMOS	VHYSCMOS	0.05*VDD	-	-	mV	
SID69	Current through protection diode to VDD/VSS	IDIODE	-	-	100	µA	
SID69A	Maximum Total Source or Sink Chip Current	ITOT_GPIO	-	-	200	mA	
GPIO AC specifications							
SID70	Rise time in Fast Strong Mode. 10% to 90% of VDD	TRISEF	-	-	2.5	ns	Cload = 15 pF, 8 mA drive strength
SID71	Fall time in Fast Strong Mode. 10% to 90% of VDD.	TFALLF	-	-	2.5	ns	Cload = 15 pF, 8 mA drive strength
SID72	Rise time in Slow Strong Mode. 10% to 90% of VDD	TRISES_1	52	-	142	ns	Cload = 15 pF, 8 mA drive strength, VDD ≤ 2.7 V
SID72A	Rise time in Slow Strong Mode. 10% to 90% of VDD	TRISES_2	48	-	102	ns	Cload = 15 pF, 8 mA drive strength, 2.7 V < VDD ≤ 3.6
SID73	Fall time in Slow Strong Mode. 10% to 90% of VDD	TFALLS_1	44	-	211	ns	Cload = 15 pF, 8 mA drive strength, VDD ≤ 2.7 V
SID73A	Fall time in Slow Strong Mode. 10% to 90% of VDD	TFALLS_2	42	-	93	ns	Cload = 15 pF, 8 mA drive strength, 2.7 V < VDD ≤ 3.6

(table continues...)

Table 10 (continued) GPIO

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID73G	Fall time (30% to 70% of VDD) in Slow Strong mode	TFALL_I2C	20×Vddio/5.5	-	250	ns	Cload = 10 pF to 400 pF, 8mA drive strength
SID74	GPIO Fout. Fast Strong mode.	FGPIOUT1	-	-	100	MHz	90/10%, 15 pF load, 60/40 duty cycle
SID75	GPIO Fout; Slow Strong mode.	FGPIOUT2	-	-	16.7	MHz	90/10%, 15 pF load, 60/40 duty cycle
SID76	GPIO Fout; Fast Strong mode.	FGPIOUT3	-	-	7	MHz	90/10%, 25 pF load, 60/40 duty cycle
SID245	GPIO Fout;Slow Strong mode.	FGPIOUT4	-	-	3.5	MHz	90/10%, 25 pF load, 60/40 duty cycle
SID246	GPIO input operating frequency; 1.71 V ≤ VDD ≤ 3.6 V	FGPIOIN	-	-	100	MHz	90/10% Vio

7.3 Analog peripherals

Table 11 Analog subsystem

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Analog peripherals							
SIDAS1	Leakage on single analog input pin	AIN_LEAK	-	0.32	12	nA	Maximum leakage at 125°C
SIDAS2	Input Capactiance of CSG	AIN_CAP_CSG	-	-	1	pF	Valid for VDDA ≥ 2.7 V
SIDAS2A	Input Capactiance of ADC	AIN_CAP_ADC	-	-	3	pF	Valid for VDDA ≥ 2.7 V
SIDAS3	Total series resistance on channel reaching CSG	AIN_RES_CSGS	-	-	500	Ω	Valid for VDDA ≥ 2.7 V
SIDAS3A	Total parallel resistance on channel reaching CSG	AIN_RES_CSGP	-	-	400	MΩ	Valid for VDDA ≥ 2.7 V
SIDAS4	Total resistance of analog channel directly connected to S/H	AIN_RES_ADC	-	-	750	Ω	Valid for VDDA ≥ 2.7 V
SIDAS4A	Total resistance of analog channel connected to S/H through AMUX	AIN_RES_ADC	-	-	2600	Ω	Valid for VDDA ≥ 2.7 V

7.3.1 LP comparator

Table 12 LPComp

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
LPComparator DC specifications							
SID84	Input offset voltage for COMP1. Normal power mode.	VOFFSET1	-10	-	10	mV	
SID85A	Input offset voltage. Low-power mode.	VOFFSET2	-25	±12	25	mV	
SID85B	Input offset voltage. Ultra low-power mode.	VOFFSET3	-25	±12	25	mV	
SID86	Hysteresis when enabled in Normal mode	VHYST1	-	-	60	mV	
SID86A	Hysteresis when enabled in Low-power mode	VHYST2	-	-	80	mV	
SID87	Input common mode voltage in Normal mode	VICM1	0	-	VDDIO1 -0.1	V	
SID247	Input common mode voltage in Low power mode	VICM2	0	-	VDDIO1 -0.1	V	
SID247A	Input common mode voltage in Ultra low power mode	VICM3	0	-	VDDIO1 -0.1	V	
SID88	Common mode rejection ratio in Normal power mode	CMRR	50	-	-	dB	
SID89	Block Current, Normal mode	ICMP1	-	-	150	µA	
SID248	Block Current, Low power mode	ICMP2	-	-	10	µA	
SID259	Block Current in Ultra low-power mode	ICMP3	-	0.3	0.85	µA	
SID90	DC Input impedance of comparator	ZCMP	35	-	-	MΩ	
LPComparator AC specifications							
SID91	Response time, Normal mode, 100 mV overdrive	TRESP1	-	-	100	ns	
SID258	Response time, Low power mode, 100 mV overdrive	TRESP2	-	-	1000	ns	
SID92	Response time, Ultra-low power mode, 100 mV overdrive	TRESP3	-	-	20	µs	
SID92E	Time from Enabling to operation	T_CMP_EN1	-	-	10	µs	Normal and Low-power modes
SID92F	Time from Enabling to operation	T_CMP_EN2	-	-	50	µs	Ultra low-power mode

7.3.2 HPPASS

Table 13 HPPASS

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
CSG DC specifications							
SIDCSG	Reference voltage for DAC	DAC_REF	-	VDDA	-	V	Supply is used as reference for the DAC
SIDCSG.0	Input referred residual offset for comparator	VOFFSET	-3	-	3	mV	
SIDCSG.1	Input common mode voltage	VCMR	0.2	-	VDDA-0.2	V	
SIDCSG.2	Operating current on VDDA at 120 MHz	IVDDA	-	-	700	µA	Includes comparator, DAC on VDDA and all internal blocks. Only one instance of CSG
SIDCSG.2A	Operating current on VCCD at 120 MHz	IVCCD	-	-	50	µA	Only for one instance of CSG
SIDCSG.3	minimum overdrive voltage at 10 MHz	OD10M	12	-	-	mV	
SIDCSG.3A	minimum overdrive voltage at 120 MHz	OD120M	100	-	-	mV	
SIDCSG.3B	minimum overdrive voltage at 80 MHz	OD80M	50	-	-	mV	
SIDCSG.4	DAC INL	INL	-1	-	2	LSB	Referred to 10-bit DAC with full scale LSB at 3.3V
SIDCSG.5	DAC DNL	DNL	-1	-	1	LSB	Referred to 10-bit DAC with full scale LSB at 3.3V
CSG AC specifications							
SIDCSG.7	Comparatror Input referred comparator noise	INPNOISE	-	-	400	µV	
SIDCSG.8	Dac settling within +-1LSB for ≥ 256 LSB change	DACSET	-	-	33	ns	Up to 1023 LSB code change
SIDCSG.8A	Dac settling within +-1LSB for ≤ 255 LSB change	DACSETA	-	-	25	ns	As low as 4 LSB code change

(table continues...)

Table 13 (continued) HPPASS

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SIDCSG.9	DAC Observability Error by the ADC (CSG accuracy and operation not affected)	DAC_OBSERR	-	-	16	LSB	LSB refers to the 10-bit DAC. Maximum error condition when | VIN-VDAC| = VDDA
			-	-	8	LSB	LSB refers to the 10-bit DAC. Maximum error condition when | VIN-VDAC| = VDDA/2
			-	-	4	LSB	LSB refers to the 10-bit DAC. Maximum error condition when | VIN-VDAC| = VDDA/4
Temperature sensor specifications							
SID93	Temperature sensor accuracy	TSENSACC	-5	±1	5	°C	-40°C to +125°C
Internal reference specifications							
SID93R		VREFBG	1.188	1.2	1.212	V	
12-bit SAR ADC DC specifications							
SIDADC	External Reference	VAREF_EXT	-	VDDA	-	V	For meeting the parameters of the ADC, it is recommended to connect reference to VAREF
SIDADC.0	SAR ADC Resolution	RES	-	-	12	bits	
SIDADC.1	Number of Sample and Hold stages - single ended	SH_S	-	-	16		
SIDADC.2	Gain Error without calibration	GAINERR_NOCAL	-5	-	5	%	LSB referred to VAREF = 3.3 V
SIDADC.3	Gain error at gain =1 after calibration	GAINERR_1	-0.1	-	0.1	%	LSB referred to VAREF = 3.3 V
SIDADC.3A	Gain error at gain =3 after calibration	GAINERR_3	-0.2	-	0.2	%	LSB referred to VAREF = 3.3 V
SIDADC.3B	Gain error at gain =6 after calibration	GAINERR_6	-0.4	-	0.4	%	LSB referred to VAREF = 3.3 V
SIDADC.3C	Gain error at gain =12 after calibration	GAINERR_12	-0.6	-	0.6	%	LSB referred to VAREF = 3.3 V
SIDADC.4	Offset Error without calibration	OFFSETERR_NOCAL	-10	-	10	mV	

(table continues...)

Table 13 (continued) HPPASS

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SIDADC.4A	Offset Error after calibration	OFFSETERR	-1.5	-	1.5	mV	
SIDADC.5A	Total unadjusted error for gain =1	TUE_G1	-4.5	-	4.5	LSB	Gain = 1, LSB referred to VAREF = 3.3 V
SIDADC.5B	Total unadjusted error for gain =3	TUE_G3	-3	-	3	LSB	Gain = 3, LSB referred to VAREF = 3.3 V
SIDADC.5C	Total unadjusted error for gain =6	TUE_G6	-3	-	3	LSB	Gain = 6, LSB referred to VAREF = 3.3 V
SIDADC.5D	Total unadjusted error for gain =12	TUE_G12	-3	-	3	LSB	Gain =12, LSB referred to VAREF = 3.3 V
SIDADC.6	Integral Non Linearity.	A_INL	-2	-	2	LSB	VAREF = 3.3 V
SIDADC.7	Differential Non Linearity.	A_DNL	-1	-	2	LSB	VAREF = 3.3 V
SIDADC.8	Current consumption	A_ISAR_1	-	-	13	mA	Current consumption on analog supply VDDA, VDDA = 3.3 V
SIDADC.9	Input voltage range	A_VINS	Vss	-	VDDA	V	When VDDA > VAREF_EXT, ADC result will saturate when VIN = VAREF_EXT
12-bit SAR ADC AC specifications							
SIDADC.9A	Analog Input voltage transient tolerated	A_VINSTRAN	-	-	VDDA + 1.5	V	Input current ≤ 3 mA. Valid for max VDDA = 3.3 V. Slew rate for VIN from VDDA to VDDA+1.5 ≥7 µs
SIADADC.10							
SIDADC.12	RMS noise	A_RMS	-	-	1	LSB	1 sigma value
SIDADC.13	Interchannel crosstalk	CROSSTALK	-1	-	1	LSB	LSB referred to VAREF = 3.3 V, for fADC ≤200 MHz
SIDADC.13A	Interchannel crosstalk for fADC > 200 MHz	CROSSTALK_240	-2	-	2	LSB	LSB referred to VAREF = 3.3 V, for fADC > 200 MHz

(table continues...)

Table 13 (continued) HPPASS

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SIDADC.14	Sample rate	A_SAMP_1	-	-	12	Msps	VDDA 2.7 - 3.6 (this includes minimum sampling time and conversion time) . fADC max = 240 MHz
SIDADC.15	Sample rate	A_SAMP_2	-	-	6	Msps	VDDA 1.7 - 2.7 (this includes minimum sampling time and conversion time). fADC max = 120 MHz
SIDADC.16	Signal-to-noise and Distortion ratio (SINAD).	A_SINAD	65	-	-	dB	Fin = 10kHz, Gain =1, VDDA 2.7 - 3.6
SIDADC.17	Start Up time after stable supply	T_STARTUP	-	-	1300	cycles	ADC clock frequency define the start up time
SIDADC.18	Maximum calibratiom time	T_CAL	-	-	2160000	Cycles	ADC clock frequency define the Calibration time. Calibration is required only after power up. After Start up calibration values will be loaded into the ADC calibration registers. Use can decide to skip the power up calibration. Calibration values are not retained when the MCU goes from Active to Deep Sleep and Hibernate mode.
SIDADC.19	Minimum sampling time for analog input through analog pad direct connection to S/H	T_SAMPLE	4	-	-	cycles	Referred to fADC
SIDADC.19B	Minimum sampling time for analog input through analog pad connected to S/H via AROUTE (AMUX)	T_SAMPLE_AROUTE	20	-	-	cycles	Referred to fADC

(table continues...)

Table 13 (continued) HPPASS

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SIDADC.19C	Minimum sampling time for analog input through GPIO or ADFT connected to S/H via AROUTE (AMUX)	T_SAMPLE_GPIO	40	-	-	cycles	Referred to fADC

7.4 Digital peripherals

7.4.1 HRPWM

Table 14 HRPWM specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SIDHRPWM.1	HRPWM Resolution	HR_RES	-	(1)/ (Fc×64)	-	ps	Max Fc = 240 MHz, resulting in typical resolution = 65.1 ps. When HRPWM feature is enabled, prescalar is not allowed to be used in PERI as well as in TCPWM Counter
SIDHRPWM.2	HRPWM is monotonic	MONOTONIC	-	Yes	-		HRPWM Monotonicity is guranteed by BIST

7.4.2 TCPWM specifications

Table 15 TCPWM specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID.TCPWM.2B	Block current consumption at 100 MHz	ITCPWM4	-	-	540	µA	All modes (Timer/ Counter/PWM)
SID.TCPWM.2C	Block current consumption at 240 MHz	ITCPWM4	-	-	1200	µA	All modes (Timer/ Counter/PWM)
SID.TCPWM.3	Operating frequency	TCPWMFREQ	-	-	240	MHz	Fc max = 240 MHz

(table continues...)

Table 15 (continued) TCPWM specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID.TCPWM.4	Input Trigger Pulse Width for all Trigger Events	TPWMENEXT	2/Fc	-	-	ns	Trigger Events can be Stop, Start, Reload, Count, Capture, or Kill depending on which mode of operation is selected.
SID.TCPWM.5	Output Trigger Pulse widths	TPWMEXT	1.5/Fc	-	-	ns	Minimum possible width of Overflow, Underflow, and CC (Counter equals Compare value) trigger outputs
SID.TCPWM.5A	Resolution of Counter	TCRES	1/Fc	-	-	ns	Minimum time between successive counts
SID.TCPWM.5B	PWM Resolution	PWMRES	1/Fc	-	-	ns	Minimum pulse width of PWM Output
SID.TCPWM.5C	Quadrature inputs resolution	QRES	2/Fc	-	-	ns	Minimum pulse width between Quadrature phase inputs. Delays from pins should be similar.

7.4.3 SCB

Table 16 SCB

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Fixed I2C DC specifications							
SID149	Block current consumption at 100 KHz	II2C1	-	-	30	µA	
SID150	Block current consumption at 400 KHz	II2C2	-	-	80	µA	
SID151	Block current consumption at 1 Mbps	II2C3	-	-	180	µA	
SID152	I2C enabled in Deep Sleep mode	II2C4	-	-	1.7	µA	At 60°C
Fixed I2C AC specifications							
SID153	Bit Rate	FI2C1	-	-	1	Mbps	

(table continues...)

Table 16 (continued) SCB

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Fixed UART DC specifications							
SID160	Block current consumption at 100 Kbits/sec	IUART1	-	-	30	µA	
SID161	Block current consumption at 1000 Kbits/sec	IUART2	-	-	180	µA	
Fixed UART AC specifications							
SID162A	Bit Rate	FUART1	-	-	3	Mbps	ULP Mode
SID162B	Bit Rate	FUART2	-	-	8	Mbps	LP Mode
Fixed SPI DC specifications							
SID163	Block current consumption at 1Mbits/sec	ISPI1	-	-	220	µA	
SID164	Block current consumption at 4 Mbits/sec	ISPI2	-	-	340	µA	
SID165	Block current consumption at 8 Mbits/sec	ISPI3	-	-	360	µA	
SID165A	Block current consumption at 25 Mbits/sec	ISP14	-	-	800	µA	
Fixed SPI AC specifications for LP Mode (1.1 V) unless noted otherwise							
SID166	SPI Operating frequency Master and Externally Clocked Slave	FSPI	-	-	25	MHz	For LP, OD mode
SID166U	SPI Operating frequency Master and Externally Clocked Slave	FSPIUL	-	-	6.25	MHz	For ULP mode
SID166A	SPI Operating frequency Master and Externally Clocked Slave for fast SCB	FSPI_HS	-	50	60	MHz	For LP mode = 50 MHz, OD mode = 60 MHz.
SID166AU	SPI Operating frequency Master and Externally Clocked Slave for fast SCB	FSPI_HS_UL	-	-	12	MHz	For ULP mode
SID166B	SPI Operating frequency Master in LP and OD mode	FSPI_EXT	-	-	FSCB/4	MHz	LP, OD mode, FSCB = 100 MHz
SID166BU	SPI Operating frequency Master in ULP mode	FSPI_EXT_UL	-	-	FSCB/4	MHz	ULP mode, FSCB = 25 MHz
SID166BHS	SPI Operating frequency Master in high speed mode in LP and OD	FSPI_EXT_HS	-	-	FSCB/4	MHz	LP/OD mode, FSCB = 200/240 MHz
SID166BHS_UL	SPI Operating frequency Master in high speed mode in ULP	FSPI_EXT_HS_UL	-	-	FSCB/4	MHz	ULP mode, FSCB = 50 MHz
SID166C	SPI Slave Internally Clocked	FSPI_IC	-	-	15	MHz	LP, OD mode, also valid for high speed SPI

(table continues...)

Table 16 (continued) SCB

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID166CUL	SPI Slave Internally Clocked	FSPI_IC_UL	-	-	5	MHz	ULP mode
Fixed SPI Master mode AC specifications for LP mode (1.1 V) unless noted otherwise							
SID167	MOSI Valid after SClock driving edge	TDMO	-	-	12	ns	LP, OD mode
SID167UL	MOSI Valid after SClock driving edge	TDMO_UL	-	-	40	ns	ULP mode
SID167HS	MOSI Valid after SClock driving edge	TDMO_HS	-	-	15	ns	LP Mode, for 50 MHz operation
SID167HS_UL	MOSI Valid after SClock driving edge	TDMO_HS_UL	-	-	75	ns	ULP Mode, for 50 MHz operation
SID168	MISO Valid before SClock capturing edge	TDSI	20	-	-	ns	LP, OD Full clock, late MISO sampling
SID168_ULP	MISO Valid before SClock capturing edge	TDSI_ULP	105	-	-	ns	ULP, Full clock, late MISO sampling
SID168HS	MISO Valid before SClock capturing edge	TDSI_HS	13	-	-	ns	LP,OD Mode, for 50 MHz operation
SID168HS_ULP	MISO Valid before SClock capturing edge	TDSI_HS_UL	22	-	-	ns	ULP Mode, for 50 MHz operation
SID169	MOSI data hold time	THMO	-5	-	-	ns	Referred to Slave capturing edge in LP and OD mode
SID169_UL	MOSI data hold time	THMO_UL	-10	-	-	ns	Referred to Slave capturing edge in ULP and MF mode
SID169HS	MOSI data hold time in HS mode	THMO_HS	-1	-	-	ns	Referred to Slave capturing edge for HS SPI in LP and OD mode
SID169HS_UL	MOSI data hold time	THMO_HS_UL	-2	-	-	ns	Referred to Slave capturing edge for HS SPI in ULP and MF mode
SID169A	SSEL Valid to first SCK Valid edge	TSSELMSCK1	20	-	-	ns	Referred to Master clock edge for all modes and SPI and HS SPI
SID169B	SSEL Hold after last SCK Valid edge	TSSELMCK2	20	-	-	ns	Referred to Master clock edge for all modes and SPI and HS SPI

(table continues...)

Table 16 (continued) SCB

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Fixed SPI Slave mode AC specifications for LP mode (1.1 V) unless noted otherwise							
SID170	MOSI Valid before Sclock Capturing edge	TDMI	5	-	-	ns	LP, OD mode
SID170_UL	MOSI Valid before Sclock Capturing edge	TDMI_UL	24	-	-	ns	ULP mode
SID170_HS	MOSI Valid before Sclock Capturing edge	TDMI_HS	4	-	-	ns	LP , OD Mode, for 50 MHz operation
SID170_HS_UL	MOSI Valid before Sclock Capturing edge	TDMI_HS_UL	14	-	-	ns	ULP, MF Mode, for 50 MHz operation
SID171A	MISO Valid after Sclock driving edge in Ext. Clk. mode	TDSO_EXT	-	-	20	ns	LP, OD mode
SID171A_UL	MISO Valid after Sclock driving edge in Ext. Clk. mode	TDSO_EXT_UL	-	-	35	ns	ULP mode
SID171A_HS	MISO Valid after Sclock driving edge in Ext. Clk. mode	TDSO_EXT_HS	-	-	16	ns	LP, OD mode, for 50 MHz operation
SID171A_HS_UL	MISO Valid after Sclock driving edge in Ext. Clk. mode	TDSO_EXT_HS_UL	-	-	25	ns	ULP , MF mode, for 50 MHz operation
SID171	MISO Valid after Sclock driving edge in Internally Clk. Mode	TDSO	-	-	TDSO_EXT + 3×Tscb	ns	Tscb is Serial Comm Block clock period.
SID171B	MISO Valid after Sclock driving edge in Internally Clk. Mode with Median filter enabled.	TDSO	-	-	TDSO_EXT + 4×Tscb	ns	Tscb is Serial Comm Block clock period.
SID172	MOSI and MISO data hold time	THSO	5	-	-	ns	
SID172A	SSEL Valid to first SCK Valid edge	TSSELSCK1	41	-	-	ns	
SID172B	SSEL Hold after Last SCK Valid edge	TSSELSCK2	41	-	-	ns	

7.5 Memory

Table 17 Memory

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Flash DC specifications							
SID173	Erase and Program voltage	VPE	1.71	-	3.6	V	Erase and program not supported at ULP levels (0.9 V)
SID173A	Erase and Program current	IPE	-	-	6	mA	

(table continues...)

Table 17 (continued) Memory

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Flash AC specifications							
SID174	Row(Block) write time (erase & program)	TROWWRITE	-	-	16	ms	Row (Block) = 512 Bytes
SID175	Row erase time	TROWERASE	-	-	11	ms	
SID176	Row program time after erase	TROWPROGRAM	-	-	5	ms	
SID178	Bulk erase time (256K Bytes)	TBULKERASE	-	-	11	ms	
SID179	Sector erase time (128K bytes)	TSECTORERASE	-	-	11	ms	256 Rows per sector
SID178S	Sub-Sector erase time	TSSERIAE	-	-	11	ms	8 Rows per sub-sector
SID179S	Sub-Sector write time; 1 erase plus 8 program times	TSSWRITE	-	-	51	ms	
SID180S	Sector write time; 1 erase plus 256 program times	TSWRITE	-	-	1.3	seconds	
SID180	Total Device Program time	TDEVPROG	-	-	2.6	seconds	
SID181	Flash Endurance	FEND	100K	-	-	cycles	
SID182	Flash Retention. Ta ≤ 25°C, 100K P/E cycles	FRET1	10	-	-	years	
SID182A	Flash Retention. Ta ≤ 85°C, 10K P/E cycles	FRET2	10	-	-	years	
SID182B	Flash Retention. Ta ≤ 55°C, 20K P/E cycles	FRET3	20	-	-	years	
SID256	Number of Wait states at 150 MHz	TWS100	-	-	8		LP Mode (1.1 V)
SID256A	Number of Wait states at 180 MHz	TWS100	-	-	9		OD Mode (1.2 V)

7.6 System Resource

7.6.1 Power-on reset (POR)

Table 18 POR

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Power-on reset with brown-out DC specifications							
SID190	BOD trip voltage in Active and Sleep modes. VDDD.	VFALLPPOR	1.54	-	-	V	BOD Reset guaranteed for levels below 1.54 V
SID192	BOD trip voltage in Deep Sleep. VDDD	VFALLDPSLP	1.54	-	-	V	
SID192A	Maximum power supply ramp rate (any supply)	VDDRAMP	-	-	100	mV/ µSec	Active Mode
POR with brown-out AC specification							
SID194A	Maximum power supply ramp rate (any supply) in Deep Sleep	VDDRAMP_DS	-	-	10	mV/ µSec	BOD operation guaranteed

7.6.2 Voltage monitors

Table 19 Voltage monitors

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
Voltage monitors DC specifications							
SID195R		VHVD0	1.18	1.23	1.27	V	
SID195		VHVDI1	1.38	1.43	1.47	V	
SID196		VHVDI2	1.57	1.63	1.68	V	
SID197		VHVDI3	1.76	1.83	1.89	V	
SID198		VHVDI4	1.95	2.03	2.1	V	
SID199		VHVDI5	2.05	2.13	2.2	V	
SID200		VHVDI6	2.15	2.23	2.3	V	
SID201		VHVDI7	2.24	2.33	2.41	V	
SID202		VHVDI8	2.34	2.43	2.51	V	
SID203		VHVDI9	2.44	2.53	2.61	V	
SID204		VHVDI10	2.53	2.63	2.72	V	
SID205		VHVDI11	2.63	2.73	2.82	V	
SID206		VHVDI12	2.73	2.83	2.92	V	
SID207		VHVDI13	2.82	2.93	3.03	V	
SID208		VHVDI14	2.92	3.03	3.13	V	

(table continues...)

Table 19 (continued) Voltage monitors

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID209		VHVDI15	3.02	3.13	3.23	V	
SID211	Block current	LVI_IDD	-	5	15	µA	
Voltage monitors AC specification							
SID212	SWD	TMONTRIP	-	-	170	ns	Need to be checked

7.6.3 Single Wire Debug (SWD) and Trace Interface

Table 20 SWD and Trace Interface

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID214	1.7 V ≤ VDDD ≤ 3.6 V	F_SWDCLK2	-	-	25	MHz	OD Mode; VCCD = 1.2 V
SID214LP	1.7 V ≤ VDDD ≤ 3.6 V	F_SWDCLK2	-	-	20	MHz	LP Mode; VCCD = 1.1 V
SID214L	1.7 V ≤ VDDD ≤ 3.6 V	F_SWDCLK2L	-	-	12	MHz	ULP and MF Mode. VCCD = 0.9 V and 1.0 V
SID215	T = 1/f SWDCLK	T_SWDI_SETUP	0.25*T	-	-	ns	
SID216	T = 1/f SWDCLK	T_SWDI_HOLD	0.25*T	-	-	ns	
SID217	T = 1/f SWDCLK	T_SWDO_VALID	-	-	0.5*T	ns	
SID217A	T = 1/f SWDCLK	T_SWDO_HOLD	1	-	-	ns	
SID214T	With Trace Data setup/hold times of 2/1 ns respectively	F_TRCLK_LP1	-	-	90	MHz	OD Mode. VDD = 1.2 V
SID215T	With Trace Data setup/hold times of 2/1 ns respectively	F_TRCLK_LP2	-	-	75	MHz	LP Mode. VDD = 1.1 V
SID216T	With Trace Data setup/hold times of 2/1 ns respectively	F_TRCLK_LP2	-	-	50	MHz	MF Mode. VDD = 1.0 V
SID217T	With Trace Data setup/hold times of 2/1 ns respectively	F_TRCLK_ULP	-	-	25	MHz	ULP Mode. VDD = 0.9 V

7.6.4 Internal oscillator crystal oscillator and external clock specifications

Table 21 Internal oscillator crystal oscillator and external clock specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
IMO DC specifications							
SID218	IMO Operating current at 8 MHz	IIMO1	-	9	15	µA	
IMO AC specifications							
SID223	Frequency variation centered on 8 MHz	FIMOTOL1	-	-	±2	%	
SID227	Cycle-to-Cycle and Period jitter	TJITR	-	250	-	ps	
IHO DC specifications							
SID218A	IHO Operating current at 48 MHz	IIHO1	-	80	100	µA	
IHO AC specifications							
SID223A	Frequency variation centered on 48 MHz	FIHOTOL1	-	-	±1	%	
SID227A	Cycle-to-Cycle and Period jitter	TJITR	-	60	-	ps	
ILO DC specifications							
SID231	ILO Operating current at 32 kHz	IILO2	-	0.3	0.7	µA	
ILO AC specifications							
SID234	ILO Start-up time	TSTARTILO1	-	-	7	µS	Startup time to 95% of final frequency
SID236	ILO Duty cycle	TLIODUTY	45	50	55	%	
SID237	32 kHz trimmed frequency	FILOTRIM1	28.8	32	35.2	KHz	±10% variation
Frequency-locked loop (FLL) specifications							
SID450	Input frequency range.	FLL_RANGE	8.	-	100	MHz	
SID451	Output frequency range. VCCD = 1.1 V	FLL_OUT_DIV2	24	-	100	MHz	Output range of FLL divided-by-2 output
SID451A	Output frequency range. VCCD = 0.9 V	FLL_OUT_DIV2	24	-	50	MHz	Output range of FLL divided-by-2 output
SID452	Divided-by-2 output; High or Low	FLL_DUTY_DIV2	47	-	53	%	
SID454	Time from stable input clock to 1% of final value on deep sleep wakeup	FLL_WAKEUP	-	-	7.5	µS	With IMO input, for < 10 C change in temperature while in Deep Sleep and Fout ≥ 50 MHz
SID455	Period jitter (1 sigma) at 100 MHz	FLL_JITTER	-	-	35	pS	50 ps at 48 MHz, 35 pS at 100 MHz

(table continues...)

Table 21 (continued) Internal oscillator crystal oscillator and external clock specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID456	CCO + Logic current	FLL_CURRENT	-	-	2	µA/MHz	
MHz ECO DC specification							
SID316	Block operating current with Cload up to 18 pF.	Idd_MHz	-	800	1600	µA	Max at 33 MHz. Typ at 16 MHz.
MHz ECO AC specification							
SID317	Crystal frequency range	F_MHz	4	-	35	MHz	
External clock specification							
SID_EXT	External clock Max input frequency	FEXT	-	-	80	MHz	In OD and LP mode, duty cycle between 45% and 55% and max rise/fall time of 20% period
SID_EXT1	External clock Max input frequency in MF mode	FEXT_MF	-	-	50	MHz	In MF mode, duty cycle between 45% and 55% and max rise/fall time of 20% period
SID_EXT2	External clock Max input frequency in ULP mode	FEXT_ULP	-	-	40	MHz	In ULP mode, duty cycle between 45% and 55% and max rise/fall time of 20% period
kHz WCO DC specification							
SID318	Block operating current with 32 kHz crystal	Idd_kHz	-	0.38	1	µA	
SID321E	Equivalent Series Resistance	ESR32K	-	80	-	kΩ	
SID322E	Drive Level	PD32K	-	-	1	µW	
kHz WCO AC specification							
SID319	32 kHz trimmed frequency	F_kHz	-	32.768	-	KHz	
SID320K	Startup time	Ton_kHz	-	-	1000	ms	
SID320E	Frequency tolerance	FTOL32K	-	50	250	ppm	May be calibrated to sub-10 ppm levels
DPLL specifications							
SIDPLL.0	Time to achieve PLL Lock at 4 MHz reference	PLL_LOCK_4M	-	-	20	µS	
SIDPLL.1	Time to achieve PLL Lock at 8 MHz reference	PLL_LOCK_8M	-	-	20	µS	

(table continues...)

Table 21 (continued) Internal oscillator crystal oscillator and external clock specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SIDPLL.2	Output frequency from PLL Block	PLL_OUT	-	160	240	MHz	
SIDPLL.3	PLL Current	PLL_IDD	-	800	1200	µA	For PLL_OUT = 240 MHz
SIDPLL.4	Period jitter	PLL_PJTR_100	-200	-	200	pS	for PLL_OUT = 100 MHz
SIDPLL.4A	Period jitter	PLL_PJTR_200	-100	-	100	pS	for PLL_OUT = 200 MHz
SIDPLL.4B	Period jitter	PLL_PJTR_240	-80	-	80	pS	for PLL_OUT = 240 MHz
SIDPLL.7	Duty Cycle	PLL_DC	45	-	55	%	for PLL_OUT = Fdco/N , N >1 and integer

7.7 Smart I/O

Table 22 Smart I/O

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID420	Smart I/O Bypass delay	SMIO_BYP	-	-	2	nS	For LP mode
SID421	Smart I/O LUT prop delay	SMIO_LUT	-	-	5	nS	For LP Mode

7.8 JTAG boundary scan specifications

Table 23 JTAG Boundary Scan specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
JTAG: parameters for 1.1 V (LP) mode operations							
SID460	TCK low Mmnimum	TCKLOW	34	-	-	nS	
SID461	TCK high	TCKHIGH	10	-	-	nS	
SID461A	Clock Period , 30 pF Load	TCK_PERIOD	-	62	-	nS	
SID462	TDO clock-to-out (max) from falling TCK	TCK_TDO	-	-	22	nS	
SID463	TDI, TMS Setup time before rising TCK.	TSU_TCK	12	-	-	nS	
SID464	TDI, TMS Hold time after rising TCK.	TCk_THD	10	-	-	nS	
SID465	TCK to TDO Data Valid (high-Z to active).	TCK_TDOV	22	-	-	nS	

(table continues...)

Table 23 (continued) JTAG Boundary Scan specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
SID466	TCK to TDO Data Valid (active to high-Z).	TCK_TDOZ	22	-	-	nS	
SID467	JTAG TDO Hold Time	JTAG_TDO_HOLD	-	-	5	nS	
SID467A	JTAG Input Transition Time	JTAG_INPUT_TRANSITION_TIME	-	-	5	nS	
JTAG: Parameters for 0.9 V (ULP) mode operations							
SID483	TCK low Mmnimum	TCKLOW	60	-	-	nS	
SID484	TCK high	TCKHIGH	20	-	-	nS	
SID485	Clock Period , 30 pF Load	TCK_PERIOD	-	80	-	nS	
SID486	TDO clock-to-out (max) from falling TCK	TCK_TDO	-	-	40	nS	
SID487	TDI, TMS Setup time before rising TCK.	TSU_TCK	20	-	-	nS	
SID488	TDI, TMS Hold time after rising TCK.	TCk_THD	20	-	-	nS	
SID489	TCK to TDO Data Valid (high-Z to active).	TCK_TDOV	50	-	-	nS	For MF mode , 40 shall be used.
SID490	TCK to TDO Data Valid (active to high-Z).	TCK_TDOZ	40	-	-	nS	
SID491	JTAG TDO Hold Time	JTAG_TDO_HOLD	-	-	5	nS	
SID492	JTAG Input Transition Time	JTAG_INPUT_TRANSITION_TIME	-	-	5	nS	
JTAG boundary scan parameters for 1.1 V (LP) mode operation:							
SID468	TCK low	TCKLOW	52	-	-	nS	
SID469	TCK high	TCKHIGH	10	-	-	nS	
SID469A	CLK_JTAG_PERIOD, 30 pF Load	TCKPERIOD	-	62	-	nS	
SID470	TCK falling edge to output valid	TCK_TDO	-	-	40	nS	
SID471	Input valid to TCK rising edge	TSU_TCK	12	-	-	nS	
SID472	Input hold time to TCK rising edge	TCk_THD	10	-	-	nS	
SID473	TCK falling edge to output valid (high-Z to active).	TCK_TDOV	40	-	-	nS	
SID474	TCK falling edge to output valid (active to high-Z).	TCK_TDOZ	40	-	-	nS	
SID474A	JTAG_BSCAN_TDO_HOLD	TCK_TDOH	-	-	5	nS	

(table continues...)

Table 23 (continued) JTAG Boundary Scan specifications

Spec ID	Parameter	Symbol	Values			Unit	Note or test condition
			Min.	Typ.	Max.		
JTAG boundary scan parameters for 0.9 V (ULP) mode operation:							
SID475	TCK low	TCKLOW	102	-	-	nS	
SID476	TCK high	TCKHIGH	20	-	-	nS	
SID476A	CLK_JTAG_PERIOD, 30 pF Load	TCKPERIOD	-	122	-	nS	
SID478	TCK falling edge to output valid	TCK_TDO	-	-	80	nS	
SID479	Input valid to TCK rising edge	TSU_TCK	22	-	-	nS	
SID480	Input hold time to TCK rising edge	TCk_THD	20	-	-	nS	
SID481	TCK falling edge to output valid (high-Z to active).	TCK_TDOV	80	-	-	nS	
SID482	TCK falling edge to output valid (active to high-Z).	TCK_TDOZ	80	-	-	nS	

8 Ordering information

Table 24 lists the PSC3P5x, PSC3M5x device part numbers and features. All devices include Arm® Cortex®-M33 with 180 MHz CPU speed, 64 KB SRAM, 2 ch CAN FD, 4 ch 32-bit timer with high-resolution PWM support, 16 ch 16-bit timer, 5x comparators, Smart I/O, and CryptoLite.

Table 24 Ordering information

Product	Flash	ADC	CORDIC accelerator	MOTIF	SCB(UART, SPI, I2C)	Pin
PSC3P5EDLGQ1	128 KB	12 Msps, 12 ch	No	-	4	VQFN-48
PSC3P5FDS2LGQ1	256 KB[1)]	12 Msps, 12 ch	No	-	4	VQFN-48
PSC3P5EDABQ1	128 KB	12 Msps, 12 ch	No	-	4	E-LQFP-48
PSC3P5FDS2ABQ1	256 KB[1)]	12 Msps, 12 ch	No	-	4	E-LQFP-48
PSC3P5EDLGQ1	128 KB	12 Msps, 18 ch	No	-	6	VQFN-64
PSC3P5FDS2LGQ1	256 KB[1)]	12 Msps, 18 ch	No	-	6	VQFN-64
PSC3P5EDACQ1	128 KB	12 Msps, 18 ch	No	-	6	E-LQFP-64
PSC3P5FDS2ACQ1	256 KB[1)]	12 Msps, 18 ch	No	-	6	E-LQFP-64
PSC3M5EDLGQ1	128 KB	12 Msps, 12 ch	Yes	Hall/Encoder	4	VQFN-48
PSC3M5FDS2LGQ1	256 KB[1)]	12 Msps, 12 ch	Yes	Hall/Encoder	4	VQFN-48
PSC3M5EDABQ1	128 KB	12 Msps, 12 ch	Yes	Hall/Encoder	4	E-LQFP-48
PSC3M5FDS2ABQ1	256 KB[1)]	12 Msps, 12 ch	Yes	Hall/Encoder	4	E-LQFP-48
PSC3M5EDLGQ1	128 KB	12 Msps, 18 ch	Yes	Hall/Encoder	6	VQFN-64
PSC3M5FDS2LGQ1	256 KB[1)]	12 Msps, 18 ch	Yes	Hall/Encoder	6	VQFN-64
PSC3M5EDACQ1	128 KB	12 Msps, 18 ch	Yes	Hall/Encoder	6	E-LQFP-64

(table continues...)

Table 24 (continued) Ordering information

Product	Flash	ADC	CORDIC accelerator	MOTIF	SCB(UART, SPI, I2C)	Pin
PSC3M5FDS2ACQ1	256 KB[1)]	12 Msps, 18 ch	Yes	Hall/Encoder	6	E-LQFP-64
PSC3M5EDAFQ1	128 KB	12 Msps, 18 ch	Yes	Hall/Encoder	6	E-LQFP-80
PSC3M5FDS2AFQ1	256 KB[1)]	12 Msps, 18 ch	Yes	Hall/Encoder	6	E-LQFP-80

1) PSA L2 certification is applicable only for devices with Flash of 256KB

8.1 Part number nomenclature

PSoC™ Control C3 MPN decoder:

PS C3 A B CC DD E FF G H II J K

Field	Description	Values	Meaning
PS	Brand	PS	Brand
C3	Family	C3	Family
A	Series	P	Power control
		M	Motor control
B	Sub-series	Entry Line	1-3
		Main Line	4-6
		Performance Line	7-9
CC	Memory (Flash/SRAM)	A	8 KB
		B	16 KB
		C	32 KB
		D	64 KB
		E	128 KB
		F	256 KB
		G	512KB
		H	768 KB
		J	1 MB
		K	2 MB
		L	3 MB

Field	Description	Values	Meaning
		M	4 MB
		N	6 MB
		O	7 MB
		P	8 MB
DD	Security	S2	PSA L2(PSA certification level)
E	Special attributes	D	Dual Core
		P	Programmable Power Control Sub-System
FF	Package	AA	EQFP-48 (0.5 mm)
		AC	EQFP-64 (0.5 mm)
		AF	EQFP-80 (0.5 mm)
		AH	QFP-100 (0.5 mm)
		AI	QFP-128 (0.5 mm)
		AE	QFP-144 (0.5 mm)
		LB	VQFN-24 (0.5 mm)
		LC	VQFN-32 (0.5 mm)
		LE	VQFN-40 (0.4 mm)
		LF	VQFN-48 (0.35 mm)
		LG	VQFN-48 (0.4 mm)
		LH	VQFN-64 (0.4 mm)
G	Temperature	C	Consumer (0°C to +70°C)
		I	Industrial (–40°C to +85°C)
		Q	Extended range (–40°C to +105°C)
H	Maximum Core Frequency	1	100 - 199 MHz
		2	200 - 299 MHz
II	Sample (Optional)	ES	Engineering Sample
J	Revision	-	Base
		A	Die revision
K	Packing (Optional)	T	Tape & Reel
		-	Tray

9 Package information

The PSC3P5x and PSC3M5x devices are offered in VQFN-48, E-LQFP-48, VQFN-64, E-LQFP-64 and E-LQFP-80 packages. For pinout details, see Pins.

Table 25 Package dimensions

Spec ID#	Package	Description	Package Dwg #
PKG_1	E-LQFP-80	E-LQFP-80, 12.0 mm x 12.0 mm x 1.4 mm height with 0.5 mm pitch, 4.6 x 4.6 mm EPAD	002-38596 Rev. *A
PKG_2	E-LQFP-64	E-LQFP-64, 10.0 mm x 10.0 mm x 1.4 mm height with 0.5 mm pitch, 4.0 x 4.0 mm EPAD	002-38595 Rev. *A
PKG_3	VQFN-48	VQFN-48, 6.0 mm x 6.0 mm x 0.85 mm height with 0.4 mm pitch, 4.5 x 4.5 mm EPAD (Sawn type)	002-38593 Rev. **

Table 26 Package characteristics

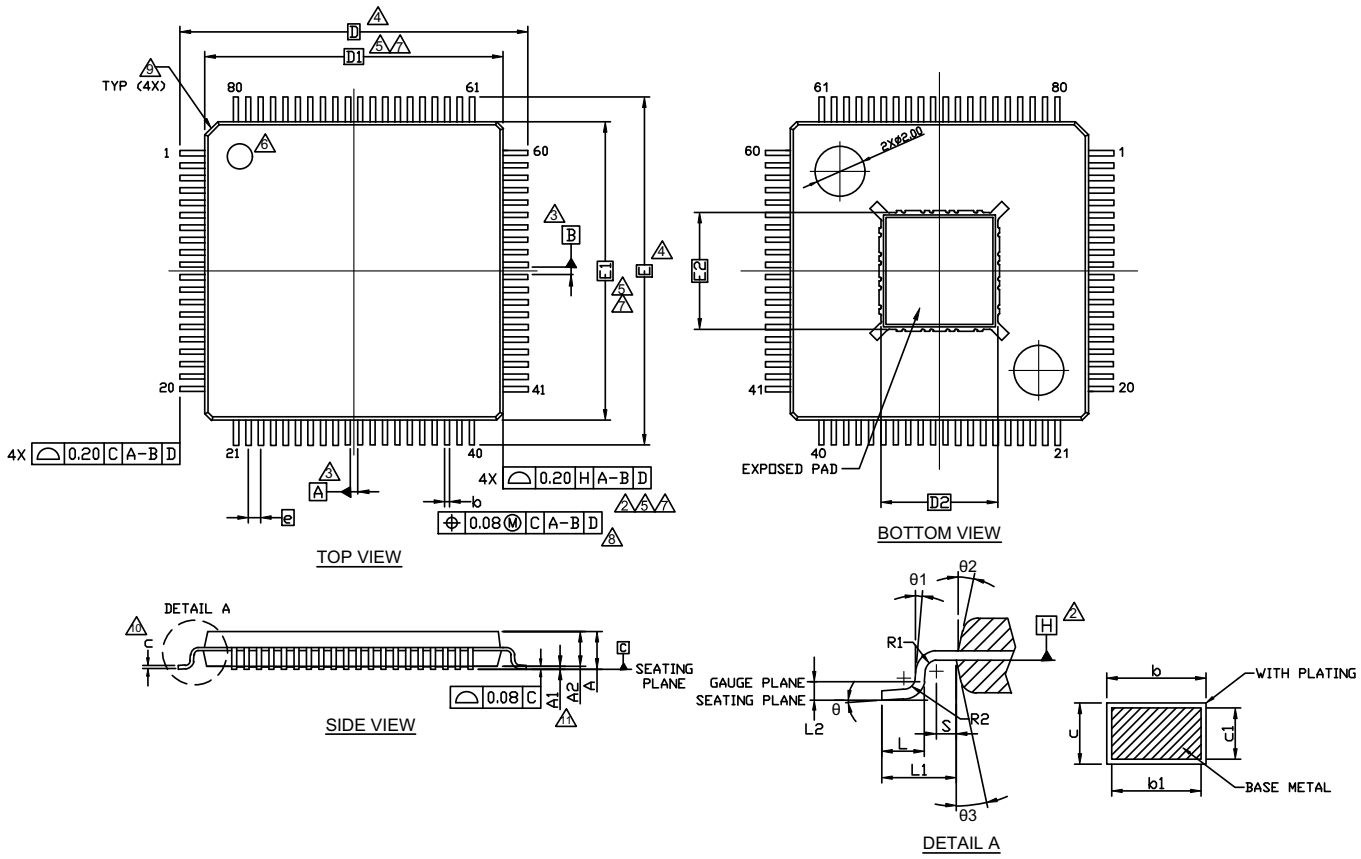
Parameter	Description	Conditions	Min	Typ	Max	Units
T_A	Operating ambient temperature	-	TBD	TBD	TBD	°C
T_J	Operating junction temperature, all packages	-	TBD	TBD	TBD	°C
T_{JA}	Package θ_{JA}	-	TBD	TBD	TBD	°C/watt
T_{JC}	Package θ_{JC}	-	TBD	TBD	TBD	°C/watt
T_{JA}	Package θ_{JA}	-	TBD	TBD	TBD	°C/watt
T_{JC}	Package θ_{JC}	-	TBD	TBD	TBD	°C/watt
T_{JA}	Package θ_{JA}	-	TBD	TBD	TBD	°C/watt
T_{JC}	Package θ_{JC}	-	TBD	TBD	TBD	°C/watt

Table 27 Solder reflow peak temperature

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

Table 28 Package moisture sensitivity level (MSL), IPC/JEDEC J-STD-2

Package	MSL
All packages	MSL3

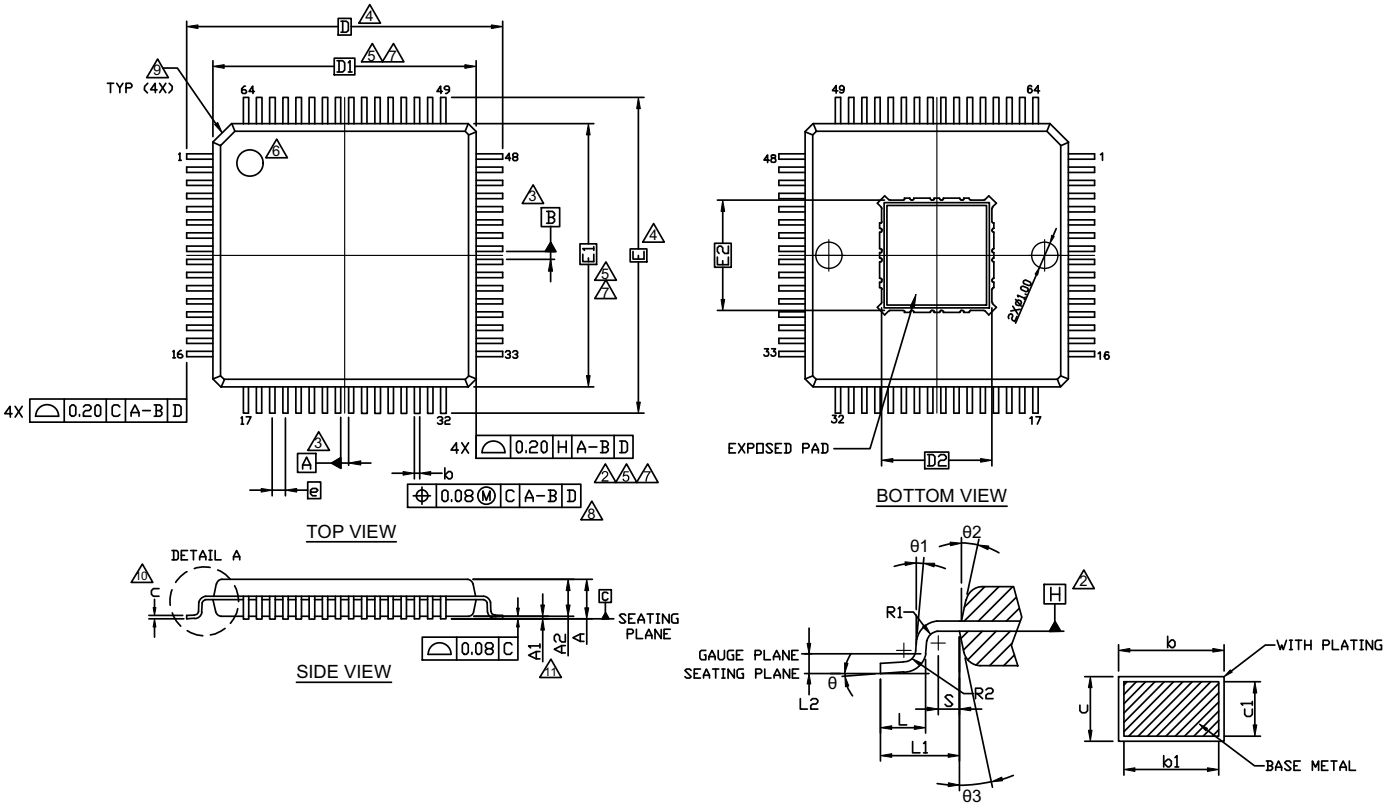


SYMBOL	DIMENSION		
	MIN.	NOM.	MAX.
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
D		14.00 BSC	
D1		12.00 BSC	
D2		4.60 REF	
E		14.00 BSC	
E1		12.00 BSC	
E2		4.60 REF	
R1	0.08	—	—
R2	0.08	—	0.20
θ	0°	3.5°	7°
θ1	0°	—	—
θ2	11°	12°	13°
θ3	11°	12°	13°
b	0.17	0.22	0.27
b1	0.17	0.20	0.23
c	0.09	—	0.20
c1	0.09	—	0.16

SYMBOL	DIMENSION		
	MIN.	NOM.	MAX.
L	0.45	0.60	0.75
L1		1.00 REF	
L2		0.25 REF	
e		0.50 BSC	
S	0.20	—	—

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
10. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
11. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

Figure 8 E-LQFP-80, 12x12x1.4 mm

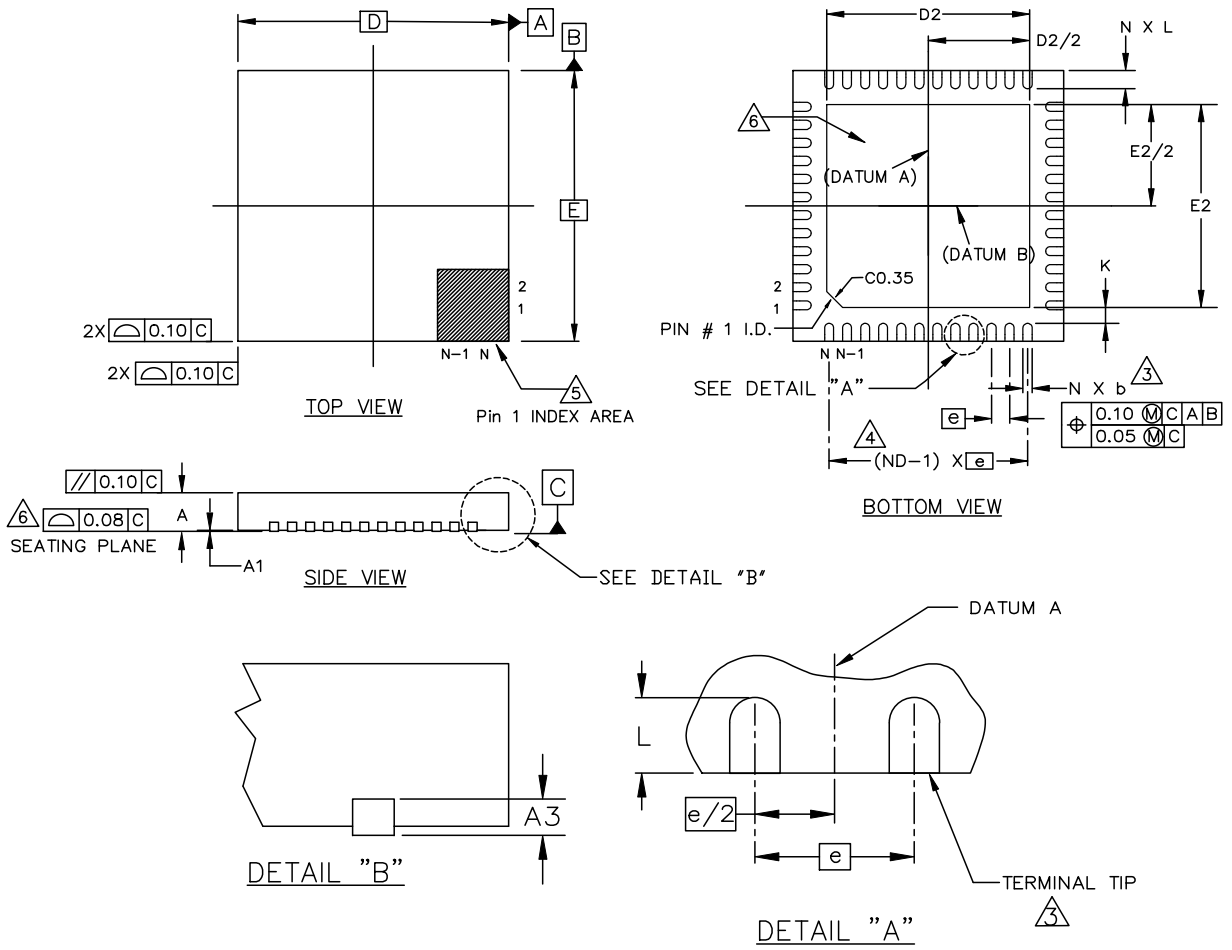


SYMBOL	DIMENSION		
	MIN.	NOM.	MAX.
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
D	12.00 BSC		
D1	10.00 BSC		
D2	4.00 REF		
E	12.00 BSC		
E1	10.00 BSC		
E2	4.00 REF		
R1	0.08	—	—
R2	0.08	—	0.20
θ	0°	3.5°	7°
θ1	0°	—	—
θ2	11°	12°	13°
θ3	11°	12°	13°
b	0.17	0.22	0.27
b1	0.17	0.20	0.23
c	0.09	—	0.20
c1	0.09	—	0.16

SYMBOL	DIMENSION		
	MIN.	NOM.	MAX.
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 REF		
e	0.50 BSC		
S	0.20	—	—

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
10. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
11. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

Figure 9 E-LQFP-64, 10x10x1.4 mm



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
e		0.40 BSC	
N		48	
ND		12	
L	0.30	0.40	0.50
b	0.15	0.20	0.25
D2	4.40	4.50	4.60
E2	4.40	4.50	4.60
D		6.00 BSC	
E		6.00 BSC	
A	-	-	0.90
A1	0.00	-	0.05
A3		0.203 REF	
K		0.35 MIN	

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. N IS THE TOTAL NUMBER OF TERMINALS.
3. DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION "b" SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
4. ND REFERS TO THE NUMBER OF TERMINALS ON D SIDE.
5. PIN #1 ID ON TOP WILL BE LOCATED WITHIN THE INDICATED ZONE.
6. COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
7. JEDEC SPECIFICATION NO. REF. : N/A.

Figure 10 VQFN-48, 6x6x0.85 mm

10 Errata

Workaround

TBD

Tracking reference

TBD

11 Acronyms

Table 29 Acronyms used in this document

Acronym	Description
ADC	analog-to-digital converter
AES	advanced encryption standard
AMUX	analog multiplexer
BLDC	brushless direct current
BOD	brown-out detect
CAN	controller area network
CORDIC	coordinate rotation digital computer
CSV	clock supervision
DAC	digital to analog converter
DFU	device firmware upgrade
DSI	digital signal interconnect
DSP	digital signal processor
DMA	direct memory access
ECC	error correcting code
ECO	external crystal oscillators
ETB	embedded trace buffer
ETM	embedded trace macrocell
FET	field effect transistor
FIFO	first in, first out
FOC	field-oriented control
FPU	floating point unit
GPIO	general-purpose input/output
HPPASS	high-performance programmable analog subsystem
HRPWM	high-resolution pulse width modulator
HSIOM	high-speed I/O matrix
I-cache	instruction-cache
I2C	inter-integrated circuit
IHO	internal high-speed oscillator
ILO	low-speed oscillator
IMO	internal main oscillator
IPC	inter-processor communication
IRQ	interrupt request

(table continues...)

Table 29 (continued) Acronyms used in this document

Acronym	Description
ISR	interrupt service routine
LPComp	low-power comparator
LUT	lookup table
LVD	low-voltage detection
LVTTL	low-voltage transistor-transistor logic
MCWDT	multi-counter watchdog timer
MPU	memory protection unit
NVIC	nested vectored interrupt controller
PAL	programmable array logic
PLD	programmable logic device
PLL	phase-locked loops
POR	power-on reset
ROM	read-only memory
RSA	rivest-shamir-adleman, a public-key cryptography algorithm
RTC	real-time clock
RWW	read-while-write
S/H	sample/hold
SAR	successive approximation register
SAU	secure attribution unit
SCB	serial communication blocks
SHA	secure hash algorithm
SPI	serial peripheral interface
SRAM	static random access memory
SRSS	system resources subsystem
TCPWM	timer/counter pulse-width modulator
TRNG	true random number generator
UART	universal asynchronous transmitter receiver
WCO	watch crystal oscillator
WIC	wakeup interrupt controller
XRES	external reset input pin

12 Document conventions

12.1 Units of measure

Table 30 Units of measure

Symbol	Unit of measure
°C	degree Celsius
KB	1024 bytes
kHz	kilohertz
Mbps	megabits per second
Msps	million samples per second
MHz	megahertz
ns	nanosecond
%	percent
V	volt

Revision history

Document version	Date of release	Description of changes
**	2022-09-26	Initial release
*A	2023-08-30	Updated the document title Added the Pins section Added the Low-power comparator (LPComp) section Updated the Block functional description section Updated TCPWM for HRPWM support Added the Ordering information section Added the Electrical specifications section
*B	2024-01-25	Updated the document title Added short product description Updated the Features section Updated the Potential applications section Updated the Description section Added chip symbol and marketing block diagram Added the Introduction section Updated Figure 1 Added the Chip-level functional description section Updated the Block functional description (previously "Functional description") Updated the Pins section Updated the Electrical specifications section Added the Package information section Added the Errata section

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