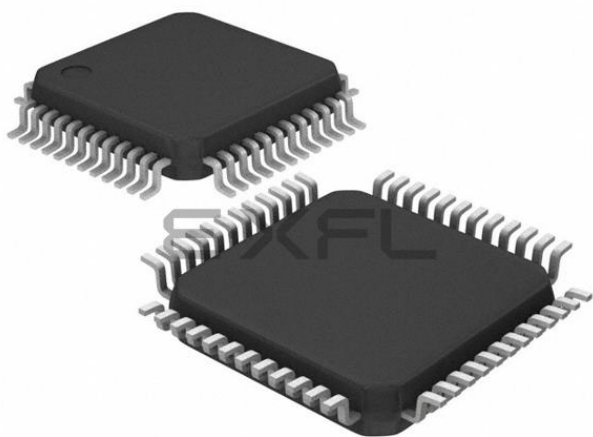




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What is "[Embedded - Microcontrollers](#)"?

"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Active
Core Processor	ARM® Cortex®-M0+
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	I ² C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, CapSense, LCD, POR, PWM, WDT
Number of I/O	36
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	1.71V ~ 5.5V
Data Converters	A/D 16x10b Slope, 16x12b SAR; D/A 2xIDAC
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-TQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/cy8c4146azi-s423t

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Reset

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

Analog Blocks

12-bit SAR ADC

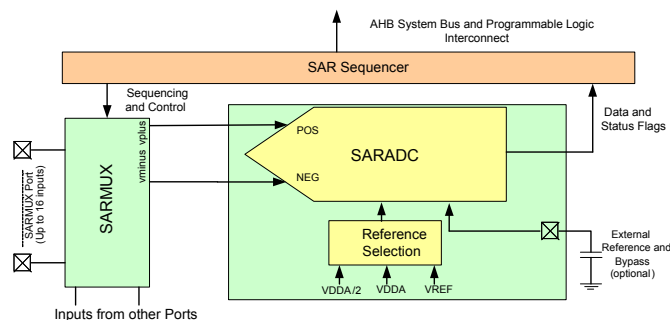
The 12-bit, 1-Msps SAR ADC can operate at a maximum clock rate of 18 MHz and requires a minimum of 18 clocks at that frequency to do a 12-bit conversion.

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

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

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

Figure 3. SAR ADC



Two Opamps (Continuous-Time Block; CTB)

The PSoC 4100S has two opamps with Comparator modes which allow most common analog functions to be performed on-chip eliminating external components; PGAs, Voltage

Buffers, Filters, Trans-Impedance Amplifiers, and other functions can be realized, in some cases with external passives, saving power, cost, and space. The on-chip opamps are designed with enough bandwidth to drive the Sample-and-Hold circuit of the ADC without requiring external buffering.

Low-power Comparators (LPC)

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

Current DACs

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

Analog Multiplexed Buses

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

Programmable Digital Blocks

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

Fixed Function Digital

Timer/Counter/PWM (TCPWM) Block

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

Serial Communication Block (SCB)

The PSoC 4100S has three serial communication blocks, which can be programmed to have SPI, I2C, or UART functionality.

I²C Mode: The hardware I²C block implements a full multi-master and slave interface (it is capable of multi-master arbitration). This block is capable of operating at speeds of up to 400 kbps (Fast Mode) and has flexible buffering options to reduce interrupt overhead and latency for the CPU. It also

supports EZI2C that creates a mailbox address range in the memory of the PSoC 4100S and effectively reduces I²C communication to reading from and writing to an array in memory. In addition, the block supports an 8-deep FIFO for receive and transmit which, by increasing the time given for the CPU to read data, greatly reduces the need for clock stretching caused by the CPU not having read data on time.

The I²C peripheral is compatible with the I²C Standard-mode and Fast-mode devices as defined in the NXP I²C-bus specification and user manual (UM10204). The I²C bus I/O is implemented with GPIO in open-drain modes.

The PSoC 4100S is not completely compliant with the I²C spec in the following respect:

- GPIO cells are not overvoltage tolerant and, therefore, cannot be hot-swapped or powered up independently of the rest of the I²C system.

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

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

GPIO

The PSoC 4100S has up to 36 GPIOs. The GPIO block implements the following:

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

The pins are organized in logical entities called ports, which are 8-bit in width (less for Ports 2 and 3). During power-on and reset, the blocks are forced to the disable state so as not to crowbar any inputs and/or cause excess turn-on current. A multiplexing network known as a high-speed I/O matrix is used to multiplex between various signals that may connect to an I/O pin.

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

Every I/O pin can generate an interrupt if so enabled and each I/O port has an interrupt request (IRQ) and interrupt service routine (ISR) vector associated with it (5 for PSoC 4100S).

Special Function Peripherals

CapSense

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

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

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

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

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

LCD Segment Drive

The PSoC 4100S has an LCD controller, which can drive up to 4 commons and up to 32 segments. It uses full digital methods to drive the LCD segments requiring no generation of internal LCD voltages. The two methods used are referred to as Digital Correlation and PWM. Digital Correlation pertains to modulating the frequency and drive levels of the common and segment signals to generate the highest RMS voltage across a segment to light it up or to keep the RMS signal to zero. This method is good for STN displays but may result in reduced contrast with TN (cheaper) displays. PWM pertains to driving the panel with PWM signals to effectively use the capacitance of the panel to provide the integration of the modulated pulse-width to generate the desired LCD voltage. This method results in higher power consumption but can result in better results when driving TN displays. LCD operation is supported during Deep Sleep refreshing a small display buffer (4 bits; 1 32-bit register per port).

Pinouts

The following table provides the pin list for PSoC 4100S for the 48-pin TQFP, 44-pin TQFP, 40-pin QFN, 32-pin QFN, and 35-ball CSP packages. All port pins support GPIO.

Table 1. Pin List

48-TQFP		44-TQFP		40-QFN		32-QFN		35-CSP	
Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name
28	P0.0	24	P0.0	22	P0.0	17	P0.0	C3	P0.0
29	P0.1	25	P0.1	23	P0.1	18	P0.1	A5	P0.1
30	P0.2	26	P0.2	24	P0.2	19	P0.2	A4	P0.2
31	P0.3	27	P0.3	25	P0.3	20	P0.3	A3	P0.3
32	P0.4	28	P0.4	26	P0.4	21	P0.4	B3	P0.4
33	P0.5	29	P0.5	27	P0.5	22	P0.5	A6	P0.5
34	P0.6	30	P0.6	28	P0.6	23	P0.6	B4	P0.6
35	P0.7	31	P0.7	29	P0.7			B5	P0.7
36	XRES	32	XRES	30	XRES	24	XRES	B6	XRES
37	VCCD	33	VCCD	31	VCCD	25	VCCD	A7	VCCD
38	VSSD			DN	VSSD	26	VSSD	B7	VSS
39	VDDD	34	VDDD	32	VDDD			C7	VDD
40	VDDA	35	VDDA	33	VDDA	27	VDD	C7	VDD
41	VSSA	36	VSSA	34	VSSA	28	VSSA	B7	VSS
42	P1.0	37	P1.0	35	P1.0	29	P1.0	C4	P1.0
43	P1.1	38	P1.1	36	P1.1	30	P1.1	C5	P1.1
44	P1.2	39	P1.2	37	P1.2	31	P1.2	C6	P1.2
45	P1.3	40	P1.3	38	P1.3	32	P1.3	D7	P1.3
46	P1.4	41	P1.4	39	P1.4			D4	P1.4
47	P1.5	42	P1.5					D5	P1.5
48	P1.6	43	P1.6					D6	P1.6
1	P1.7/VREF	44	P1.7/VREF	40	P1.7/VREF	1	P1.7/VREF	E7	P1.7/VREF
		1	VSSD						
2	P2.0	2	P2.0	1	P2.0	2	P2.0		
3	P2.1	3	P2.1	2	P2.1	3	P2.1		
4	P2.2	4	P2.2	3	P2.2	4	P2.2	D3	P2.2
5	P2.3	5	P2.3	4	P2.3	5	P2.3	E4	P2.3
6	P2.4	6	P2.4	5	P2.4			E5	P2.4
7	P2.5	7	P2.5	6	P2.5	6	P2.5	E6	P2.5
8	P2.6	8	P2.6	7	P2.6	7	P2.6	E3	P2.6
9	P2.7	9	P2.7	8	P2.7	8	P2.7	E2	P2.7
10	VSSD	10	VSSD	9	VSSD				
12	P3.0	11	P3.0	10	P3.0	9	P3.0	E1	P3.0
13	P3.1	12	P3.1	11	P3.1	10	P3.1	D2	P3.1
14	P3.2	13	P3.2	12	P3.2	11	P3.2	D1	P3.2
16	P3.3	14	P3.3	13	P3.3	12	P3.3	C1	P3.3
17	P3.4	15	P3.4	14	P3.4			C2	P3.4
18	P3.5	16	P3.5	15	P3.5				

Electrical Specifications

Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings^[1]

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

Device Level Specifications

All specifications are valid for $-40\text{ }^{\circ}\text{C} \leq T_A \leq 85\text{ }^{\circ}\text{C}$ and $T_J \leq 100\text{ }^{\circ}\text{C}$, except where noted. Specifications are valid for 1.71 V to 5.5 V, except where noted.

Table 3. DC Specifications

Typical values measured at V_{DD} = 3.3 V and 25 °C.

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID53	V _{DD}	Power supply input voltage	1.8	—	5.5	V	Internally regulated supply
SID255	V _{DD}	Power supply input voltage (V _{CCD} = V _{DDD} = V _{DDA})	1.71	—	1.89		Internally unregulated supply
SID54	V _{CCD}	Output voltage (for core logic)	—	1.8	—		—
SID55	C _{EFC}	External regulator voltage bypass	—	0.1	—	μF	X5R ceramic or better
SID56	C _{EXC}	Power supply bypass capacitor	—	1	—		X5R ceramic or better

Active Mode, V_{DD} = 1.8 V to 5.5 V. Typical values measured at V_{DD} = 3.3 V and 25 °C.

SID10	I _{DD5}	Execute from flash; CPU at 6 MHz	—	1.8	2.7	mA	Max is at 85 °C and 5.5 V
SID16	I _{DD8}	Execute from flash; CPU at 24 MHz	—	3.0	4.75		Max is at 85 °C and 5.5 V
SID19	I _{DD11}	Execute from flash; CPU at 48 MHz	—	5.4	6.85		Max is at 85 °C and 5.5 V

Note

- Usage above the absolute maximum conditions listed in Table 2 may cause permanent damage to the device. Exposure to Absolute Maximum conditions for extended periods of time may affect device reliability. The Maximum Storage Temperature is 150 °C in compliance with JEDEC Standard JESD22-A103, High Temperature Storage Life. When used below Absolute Maximum conditions but above normal operating conditions, the device may not operate to specification.

Table 3. DC Specifications (continued)

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

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
Sleep Mode, VDDD = 1.8 V to 5.5 V (Regulator on)							
SID22	IDD17	I ² C wakeup WDT, and Comparators on	–	1.7	2.2	mA	6 MHZ. Max is at 85 °C and 5.5 V.
SID25	IDD20	I ² C wakeup, WDT, and Comparators on.	–	2.2	2.5		12 MHZ. Max is at 85 °C and 5.5 V.
Sleep Mode, VDD = 1.71 V to 1.89 V (Regulator bypassed)							
SID28	IDD23	I ² C wakeup, WDT, and Comparators on	–	0.7	0.9	mA	6 MHZ. Max is at 85 °C and 5.5 V.
SID28A	IDD23A	I ² C wakeup, WDT, and Comparators on	–	1	1.2	mA	12 MHZ. Max is at 85 °C and 5.5 V.
Deep Sleep Mode, VDD = 1.8 V to 3.6 V (Regulator on)							
SID31	IDD26	I ² C wakeup and WDT on	–	2.5	60	μA	Max is at 3.6 V and 85 °C.
Deep Sleep Mode, VDD = 3.6 V to 5.5 V (Regulator on)							
SID34	IDD29	I ² C wakeup and WDT on	–	2.5	60	μA	Max is at 5.5 V and 85 °C.
Deep Sleep Mode, VDD = VCCD = 1.71 V to 1.89 V (Regulator bypassed)							
SID37	IDD32	I ² C wakeup and WDT on	–	2.5	65	μA	Max is at 1.89 V and 85 °C.
XRES Current							
SID307	IDD_XR	Supply current while XRES asserted	–	2	5	mA	–

Table 4. AC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID48	F _{CPU}	CPU frequency	DC	–	48	MHz	$1.71 \leq V_{DD} \leq 5.5$
SID49 ^[3]	T _{SLEEP}	Wakeup from Sleep mode	–	0	–	μs	
SID50 ^[3]	T _{DEEPSLEEP}	Wakeup from Deep Sleep mode	–	35	–		

Note

2. Guaranteed by characterization.

Table 6. GPIO AC Specifications

(Guaranteed by Characterization) (continued)

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID73	T_{FALLS}	Fall time in slow strong mode	10	–	60	–	3.3 V V_{DD} , Load = 25 pF
SID74	$F_{GPIOOUT1}$	GPIO F_{OUT} ; 3.3 V $\leq V_{DD} \leq 5.5$ V Fast strong mode	–	–	33	MHz	90/10%, 25 pF load, 60/40 duty cycle
SID75	$F_{GPIOOUT2}$	GPIO F_{OUT} ; 1.71 V $\leq V_{DD} \leq 3.3$ V Fast strong mode	–	–	16.7		90/10%, 25 pF load, 60/40 duty cycle
SID76	$F_{GPIOOUT3}$	GPIO F_{OUT} ; 3.3 V $\leq V_{DD} \leq 5.5$ V Slow strong mode	–	–	7		90/10%, 25 pF load, 60/40 duty cycle
SID245	$F_{GPIOOUT4}$	GPIO F_{OUT} ; 1.71 V $\leq V_{DD} \leq 3.3$ V Slow strong mode.	–	–	3.5		90/10%, 25 pF load, 60/40 duty cycle
SID246	F_{GPIOIN}	GPIO input operating frequency; 1.71 V $\leq V_{DD} \leq 5.5$ V	–	–	48		90/10% V_{IO}

XRES

Table 7. XRES DC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID77	V_{IH}	Input voltage high threshold	$0.7 \times V_{DD}$	–	–	V	CMOS Input
SID78	V_{IL}	Input voltage low threshold	–	–	$0.3 \times V_{DD}$		
SID79	R_{PULLUP}	Pull-up resistor	–	60	–	k Ω	–
SID80	C_{IN}	Input capacitance	–	–	7	pF	–
SID81 ^[5]	$V_{HYSXRES}$	Input voltage hysteresis	–	100	–	mV	Typical hysteresis is 200 mV for $V_{DD} > 4.5$ V
SID82	I_{DIODE}	Current through protection diode to V_{DD}/V_{SS}	–	–	100	μ A	

Table 8. XRES AC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID83 ^[5]	$T_{RESETWIDTH}$	Reset pulse width	1	–	–	μ s	–
BID194 ^[5]	$T_{RESETWAKE}$	Wake-up time from reset release	–	–	2.7	ms	–

Note

5. Guaranteed by characterization.

Analog Peripherals

Table 9. CTBm Opamp Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
	I _{DD}	Opamp block current, External load					
SID269	I _{DD_HI}	power=hi	–	1100	1850	μA	–
SID270	I _{DD_MED}	power=med	–	550	950		–
SID271	I _{DD_LOW}	power=lo	–	150	350		–
	G _{BW}	Load = 20 pF, 0.1 mA V _{D_{DDA}} = 2.7 V					
SID272	G _{BW_HI}	power=hi	6	–	–	MHz	Input and output are 0.2 V to V _{D_{DDA}} -0.2 V
SID273	G _{BW_MED}	power=med	3	–	–		Input and output are 0.2 V to V _{D_{DDA}} -0.2 V
SID274	G _{BW_LO}	power=lo	–	1	–		Input and output are 0.2 V to V _{D_{DDA}} -0.2 V
	I _{OUT_MAX}	V _{D_{DDA}} = 2.7 V, 500 mV from rail					
SID275	I _{OUT_MAX_HI}	power=hi	10	–	–	mA	Output is 0.5 V V _{D_{DDA}} -0.5 V
SID276	I _{OUT_MAX_MID}	power=mid	10	–	–		Output is 0.5 V V _{D_{DDA}} -0.5 V
SID277	I _{OUT_MAX_LO}	power=lo	–	5	–		Output is 0.5 V V _{D_{DDA}} -0.5 V
	I _{OUT}	V _{D_{DDA}} = 1.71 V, 500 mV from rail					
SID278	I _{OUT_MAX_HI}	power=hi	4	–	–	mA	Output is 0.5 V V _{D_{DDA}} -0.5 V
SID279	I _{OUT_MAX_MID}	power=mid	4	–	–		Output is 0.5 V V _{D_{DDA}} -0.5 V
SID280	I _{OUT_MAX_LO}	power=lo	–	2	–		Output is 0.5 V V _{D_{DDA}} -0.5 V
	I _{DD_Int}	Opamp block current Internal Load					
SID269_I	I _{DD_HI_Int}	power=hi	–	1500	1700	μA	–
SID270_I	I _{DD_MED_Int}	power=med	–	700	900		–
SID271_I	I _{DD_LOW_Int}	power=lo	–	–	–		–
	G _{BW}	V _{D_{DDA}} = 2.7 V	–	–	–	–	
SID272_I	G _{BW_HI_Int}	power=hi	8	–	–	MHz	Output is 0.25 V to V _{D_{DDA}} -0.25 V

Table 9. CTBm Opamp Specifications (continued)

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID299	T_OP_WAKE	From disable to enable, no external RC dominating	–	–	25	µs	–
SID299A	OL_GAIN	Open Loop Gain	–	90	–	dB	
	COMP_MODE	Comparator mode; 50 mV drive, $T_{rise}=T_{fall}$ (approx.)					
SID300	TPD1	Response time; power=hi	–	150	–	ns	Input is 0.2 V to $V_{DDA}-0.2$ V
SID301	TPD2	Response time; power=med	–	500	–		Input is 0.2 V to $V_{DDA}-0.2$ V
SID302	TPD3	Response time; power=lo	–	2500	–		Input is 0.2 V to $V_{DDA}-0.2$ V
SID303	VHYST_OP	Hysteresis	–	10	–	mV	–
SID304	WUP_CTB	Wake-up time from Enabled to Usable	–	–	25	µs	–
	Deep Sleep Mode	Mode 2 is lowest current range. Mode 1 has higher GBW.					
SID_DS_1	I _{DD_HI_M1}	Mode 1, High current	–	1400	–	µA	25 °C
SID_DS_2	I _{DD_MED_M1}	Mode 1, Medium current	–	700	–		25 °C
SID_DS_3	I _{DD_LOW_M1}	Mode 1, Low current	–	200	–		25 °C
SID_DS_4	I _{DD_HI_M2}	Mode 2, High current	–	120	–		25 °C
SID_DS_5	I _{DD_MED_M2}	Mode 2, Medium current	–	60	–		25 °C
SID_DS_6	I _{DD_LOW_M2}	Mode 2, Low current	–	15	–		25 °C

Table 10. Comparator DC Specifications

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

Table 11. Comparator AC Specifications

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

Table 12. Temperature Sensor Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details / Conditions
SID93	TSENSACC	Temperature sensor accuracy	–5	±1	5	°C	–40 to +85 °C

Table 13. SAR Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SAR ADC DC Specifications							
SID94	A_RES	Resolution	–	–	12	bits	
SID95	A_CHNLS_S	Number of channels - single ended	–	–	16		
SID96	A-CHNKS_D	Number of channels - differential	–	–	4		Diff inputs use neighboring I/O
SID97	A-MONO	Monotonicity	–	–	–		Yes.
SID98	A_GAINERR	Gain error	–	–	±0.1	%	With external reference.

Table 13. SAR Specifications (continued)

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID99	A_OFFSET	Input offset voltage	–	–	2	mV	Measured with 1-V reference
SID100	A_ISAR	Current consumption	–	–	1	mA	
SID101	A_VINS	Input voltage range - single ended	V _{SS}	–	V _{DDA}	V	
SID102	A_VIND	Input voltage range - differential[	V _{SS}	–	V _{DDA}	V	
SID103	A_INRES	Input resistance	–	–	2.2	KΩ	
SID104	A_INCAP	Input capacitance	–	–	10	pF	
SID260	VREFSAR	Trimmed internal reference to SAR	–	–	TBD	V	
SAR ADC AC Specifications							
SID106	A_PSRR	Power supply rejection ratio	70	–	–	dB	
SID107	A_CMRR	Common mode rejection ratio	66	–	–	dB	Measured at 1 V
SID108	A_SAMP	Sample rate	–	–	1	Msps	
SID109	A_SNR	Signal-to-noise and distortion ratio (SINAD)	65	–	–	dB	F _{IN} = 10 kHz
SID110	A_BW	Input bandwidth without aliasing	–	–	A _{samp} /2	kHz	
SID111	A_INL	Integral non linearity. V _{DD} = 1.71 to 5.5, 1 Msps	–1.7	–	2	LSB	V _{REF} = 1 to V _{DD}
SID111A	A_INL	Integral non linearity. V _{DD} = 1.71 to 3.6, 1 Msps	–1.5	–	1.7	LSB	V _{REF} = 1.71 to V _{DD}
SID111B	A_INL	Integral non linearity. V _{DD} = 1.71 to 5.5, 500 ksps	–1.5	–	1.7	LSB	V _{REF} = 1 to V _{DD}
SID112	A_DNL	Differential non linearity. V _{DD} = 1.71 to 5.5, 1 Msps	–1	–	2.2	LSB	V _{REF} = 1 to V _{DD}
SID112A	A_DNL	Differential non linearity. V _{DD} = 1.71 to 3.6, 1 Msps	–1	–	2	LSB	V _{REF} = 1.71 to V _{DD}
SID112B	A_DNL	Differential non linearity. V _{DD} = 1.71 to 5.5, 500 ksps	–1	–	2.2	LSB	V _{REF} = 1 to V _{DD}
SID113	A_THD	Total harmonic distortion	–	–	–65	dB	F _{in} = 10 kHz
SID261	FSARINTRE F	SAR operating speed without external ref. bypass	–	–	100	ksps	12-bit resolution

Table 14. CSD and IDAC Specifications (continued)

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

Table 15. 10-bit CapSense ADC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SIDA94	A_RES	Resolution	–	–	10	bits	Auto-zeroing is required every millisecond
SIDA95	A_CHNLS_S	Number of channels - single ended	–	–	16		Defined by AMUX Bus.
SIDA97	A-MONO	Monotonicity	–	–	–	Yes	
SIDA98	A_GAINERR	Gain error	–	–	±2	%	In V _{REF} (2.4 V) mode with V _{DDA} bypass capacitance of 10 µF
SIDA99	A_OFFSET	Input offset voltage	–	–	3	mV	In V _{REF} (2.4 V) mode with V _{DDA} bypass capacitance of 10 µF
SIDA100	A_ISAR	Current consumption	–	–	0.25	mA	
SIDA101	A_VINS	Input voltage range - single ended	V _{SSA}	–	V _{DDA}	V	
SIDA103	A_INRES	Input resistance	–	2.2	–	KΩ	
SIDA104	A_INCAP	Input capacitance	–	20	–	pF	
SIDA106	A_PSRR	Power supply rejection ratio	–	60	–	dB	In V _{REF} (2.4 V) mode with V _{DDA} bypass capacitance of 10 µF
SIDA107	A_TACQ	Sample acquisition time	–	1	–	µs	
SIDA108	A_CONV8	Conversion time for 8-bit resolution at conversion rate = F _{clk} /(2 ^{N+2}). Clock frequency = 48 MHz.	–	–	21.3	µs	Does not include acquisition time. Equivalent to 44.8 ksp/s including acquisition time.
SIDA108A	A_CONV10	Conversion time for 10-bit resolution at conversion rate = F _{clk} /(2 ^{N+2}). Clock frequency = 48 MHz.	–	–	85.3	µs	Does not include acquisition time. Equivalent to 11.6 ksp/s including acquisition time.

Table 34. Watch Crystal Oscillator (WCO) Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details / Conditions
SID398	FWCO	Crystal Frequency	–	32.768	–	kHz	
SID399	FTOL	Frequency tolerance	–	50	250	ppm	With 20-ppm crystal
SID400	ESR	Equivalent series resistance	–	50	–	kΩ	
SID401	PD	Drive Level	–	–	1	μW	
SID402	TSTART	Startup time	–	–	500	ms	
SID403	CL	Crystal Load Capacitance	6	–	12.5	pF	
SID404	C0	Crystal Shunt Capacitance	–	1.35	–	pF	
SID405	IWCO1	Operating Current (high power mode)	–	–	8	uA	
SID406	IWCO2	Operating Current (low power mode)	–	–	1	uA	

Table 35. External Clock Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID305 ^[13]	ExtClkFreq	External clock input frequency	0	–	48	MHz	–
SID306 ^[13]	ExtClkDuty	Duty cycle; measured at V _{DD/2}	45	–	55	%	–

Table 36. Block Specs

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID262 ^[13]	T _{CLKSWITCH}	System clock source switching time	3	–	4	Periods	–

Table 37. Smart I/O Pass-through Time (Delay in Bypass Mode)

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

Note

13. Guaranteed by characterization.

Ordering Information

The marketing part numbers for the PSoC 4100S family are listed in the following table.

Category	MPN	Features														Package				
		Max CPU Speed (MHz)	Flash (KB)	SRAM (KB)	Opamp (CTBm)	CSD	10-bit CSD ADC	12-bit SAR ADC	ADC Sample Rate	LP Comparators	TCPWM Blocks	SCB Blocks	Smart I/Os	GPIO	35-WLCSP (0.35mm pitch)	32-QFN	40-QFN	48-TQFP	44-TQFP	
4124	CY8C4124FNI-S403	24	16	4	2	0	1	0		2	5	2	8	31	X					
	CY8C4124FNI-S413	24	16	4	2	1	1	0		2	5	2	16	31	X					
	CY8C4124LQI-S412	24	16	4	2	1	1	0		2	5	2	16	27		X				
	CY8C4124LQI-S413	24	16	4	2	1	1	0		2	5	2	16	34			X			
	CY8C4124AZI-S413	24	16	4	2	1	1	0		2	5	2	16	36				X		
	CY8C4124FNI-S433	24	16	4	2	1	1	1	806 ksp/s	2	5	2	16	31	X					
	CY8C4124LQI-S432	24	16	4	2	1	1	1	806 ksp/s	2	5	2	16	27		X				
	CY8C4124LQI-S433	24	16	4	2	1	1	1	806 ksp/s	2	5	2	16	34			X			
4125	CY8C4124AZI-S433	24	16	4	2	1	1	1	806 ksp/s	2	5	2	16	36				X		
	CY8C4125FNI-S423	24	32	4	2	0	1	1	806 ksp/s	2	5	2	16	31	X					
	CY8C4125LQI-S422	24	32	4	2	0	1	1	806 ksp/s	2	5	2	16	27		X				
	CY8C4125LQI-S423	24	32	4	2	0	1	1	806 ksp/s	2	5	2	16	34			X			
	CY8C4125AZI-S423	24	32	4	2	0	1	1	806 ksp/s	2	5	2	16	36				X		
	CY8C4125AXI-S423	24	32	4	2	0	1	1	806 ksp/s	2	5	2	16	36					X	
	CY8C4125FNI-S413	24	32	4	2	1	1	0		2	5	2	16	31	X					
	CY8C4125LQI-S412	24	32	4	2	1	1	0		2	5	2	16	27		X				
	CY8C4125LQI-S413	24	32	4	2	1	1	0		2	5	2	16	34			X			
	CY8C4125AZI-S413	24	32	4	2	1	1	0		2	5	2	16	36				X		
	CY8C4125FNI-S433	24	32	4	2	1	1	1	806 ksp/s	2	5	2	16	31	X					
	CY8C4125LQI-S432	24	32	4	2	1	1	1	806 ksp/s	2	5	2	16	27		X				
	CY8C4125LQI-S433	24	32	4	2	1	1	1	806 ksp/s	2	5	2	16	34			X			
	CY8C4125AZI-S433	24	32	4	2	1	1	1	806 ksp/s	2	5	2	16	36				X		
CY8C4125AXI-S433	24	32	4	2	1	1	1	806 ksp/s	2	5	2	16	36					X		
4126	CY8C4126AZI-S423	24	64	8	2	0	1	1	806 ksp/s	2	5	3	16	36				X		
	CY8C4126AXI-S423	24	64	8	2	0	1	1	806 ksp/s	2	5	3	16	36					X	
	CY8C4126AZI-S433	24	64	8	2	1	1	1	806 ksp/s	2	5	3	16	36				X		
	CY8C4126AXI-S433	24	64	8	2	1	1	1	806 ksp/s	2	5	3	16	36					X	
4145	CY8C4145AZI-S423	48	32	4	2	0	1	1	1 Msps	2	5	2	16	36				X		
	CY8C4145AXI-S423	48	32	4	2	0	1	1	1 Msps	2	5	2	16	36					X	
	CY8C4145AXI-S433	48	32	4	2	1	1	1	1 Msps	2	5	2	16	36					X	
4146	CY8C4146FNI-S423	48	64	8	2	0	1	1	1 Msps	2	5	3	16	31	X					
	CY8C4146LQI-S422	48	64	8	2	0	1	1	1 Msps	2	5	3	16	27		X				
	CY8C4146LQI-S423	48	64	8	2	0	1	1	1 Msps	2	5	3	16	34			X			
	CY8C4146AZI-S423	48	64	8	2	0	1	1	1 Msps	2	5	3	16	36				X		
	CY8C4146AXI-S423	48	64	8	2	0	1	1	1 Msps	2	5	3	16	36					X	
	CY8C4146FNI-S433	48	64	8	2	1	1	1	1 Msps	2	5	3	16	31	X					
	CY8C4146LQI-S432	48	64	8	2	1	1	1	1 Msps	2	5	3	16	27		X				
	CY8C4146LQI-S433	48	64	8	2	1	1	1	1 Msps	2	5	3	16	34			X			
	CY8C4146AZI-S433	48	64	8	2	1	1	1	1 Msps	2	5	3	16	36				X		
	CY8C4146AXI-S433	48	64	8	2	1	1	1	1 Msps	2	5	3	16	36					X	

Packaging

The PSoC 4100S will be offered in 48-pin TQFP, 44-pin TQFP, 40-pin QFN, 32-pin QFN, and 35-ball WLCSP packages. Package dimensions and Cypress drawing numbers are in the following table.

Table 38. Package List

Spec ID#	Package	Description	Package Dwg
BID20	48-pin TQFP	7 × 7 × 1.4-mm height with 0.5-mm pitch	51-85135
BID20A	44-pin TQFP	10 × 10 × 1.6-mm height with 0.8-mm pitch	51-85064
BID27	40-pin QFN	6 × 6 × 0.6-mm height with 0.5-mm pitch	001-80659
BID34A	32-pin QFN	5 × 5 × 0.6-mm height with 0.5-mm pitch	001-42168
BID34D	35-ball WLCSP	2.6 × 2.1 × 0.48-mm height with 0.35-mm pitch	002-09958

Table 39. Package Thermal Characteristics

Parameter	Description	Package	Min	Typ	Max	Units
T _A	Operating Ambient temperature		−40	25	85	°C
T _J	Operating junction temperature		−40	—	100	°C
T _{JA}	Package θ _{JA}	48-pin TQFP	—	74.8	—	°C/Watt
T _{JC}	Package θ _{JC}	48-pin TQFP	—	35.7	—	°C/Watt
T _{JA}	Package θ _{JA}	44-pin TQFP	—	57.2	—	°C/Watt
T _{JC}	Package θ _{JC}	44-pin TQFP	—	17.5	—	°C/Watt
T _{JA}	Package θ _{JA}	40-pin QFN	—	17.8	—	°C/Watt
T _{JC}	Package θ _{JC}	40-pin QFN	—	2.8	—	°C/Watt
T _{JA}	Package θ _{JA}	32-pin QFN	—	19.9	—	°C/Watt
T _{JC}	Package θ _{JC}	32-pin QFN	—	4.3	—	°C/Watt
T _{JA}	Package θ _{JA}	35-ball WLCSP	—	43	—	°C/Watt
T _{JC}	Package θ _{JC}	35-ball WLCSP	—	0.3	—	°C/Watt

Table 40. Solder Reflow Peak Temperature

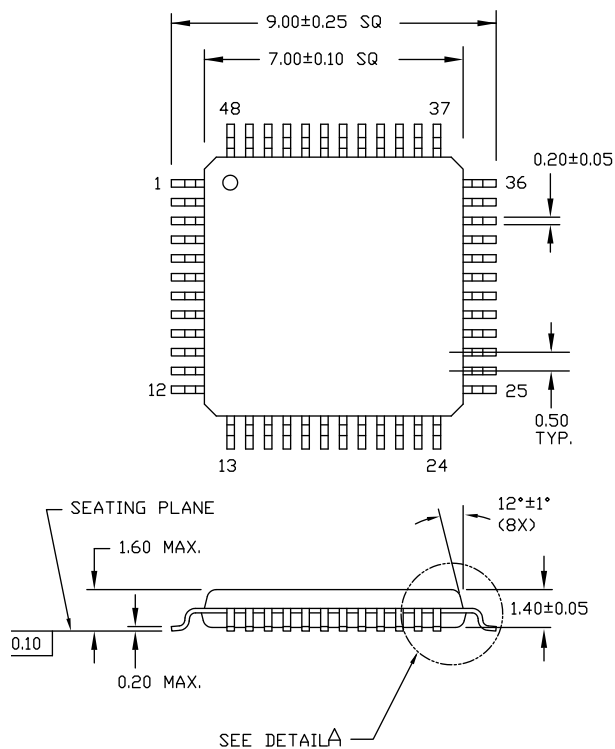
Package	Maximum Peak Temperature	Maximum Time at Peak Temperature
All	260 °C	30 seconds

Table 41. Package Moisture Sensitivity Level (MSL), IPC/JEDEC J-STD-020

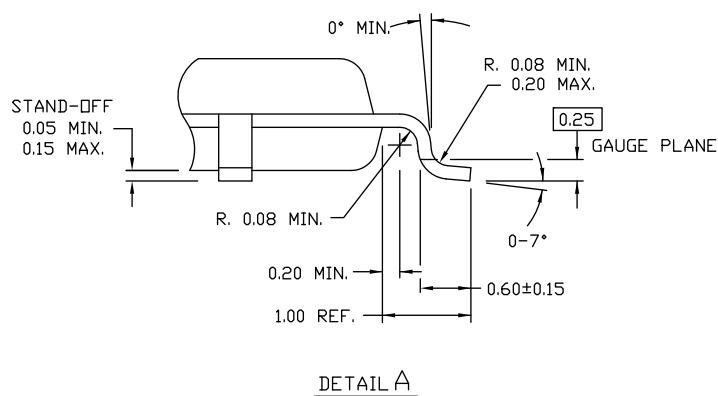
Package	MSL
All except WLCSP	MSL 3
35-ball WLCSP	MSL 1

Package Diagrams

Figure 6. 48-pin TQFP Package Outline

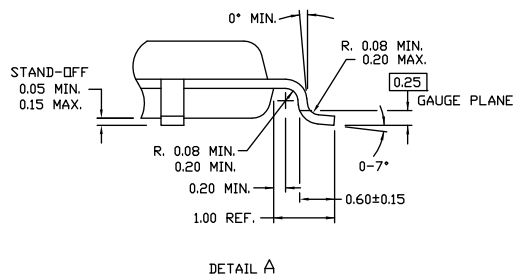
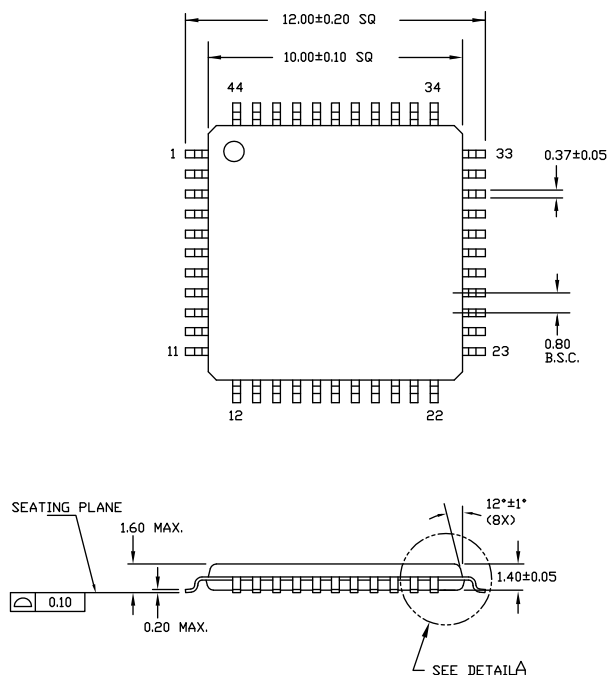


DIMENSIONS ARE IN MILLIMETERS



51-85135 *C

Figure 7. 44-pin TQFP Package Outline

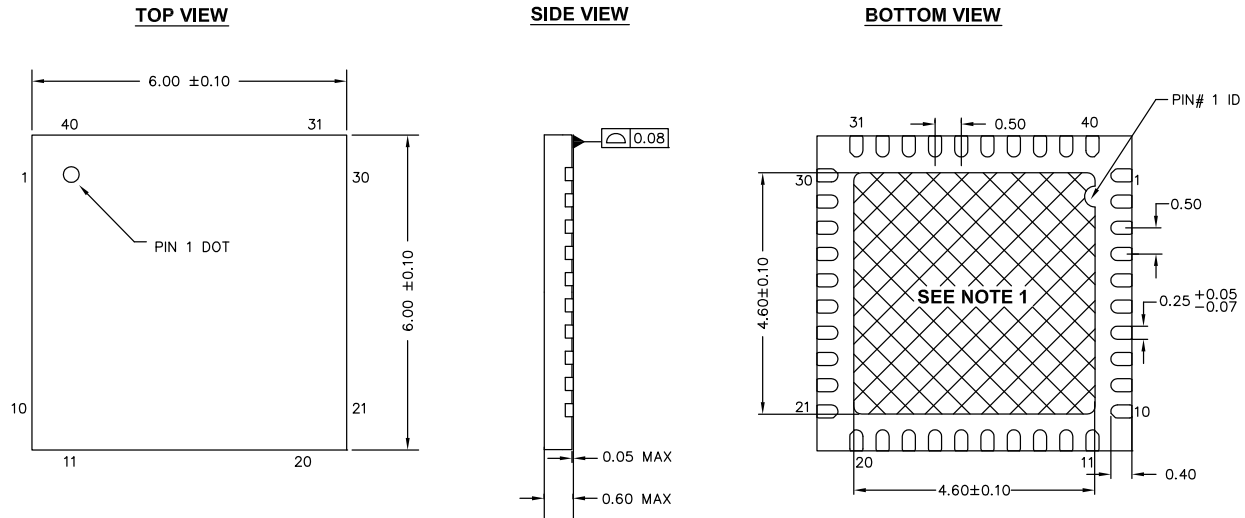


NOTE:

1. JEDEC STD REF MS-026
2. BODY LENGTH DIMENSION DOES NOT INCLUDE MOLD PROTRUSION/END FLASH
MOLD PROTRUSION/END FLASH SHALL NOT EXCEED 0.0098 in (0.25 mm) PER SIDE
BODY LENGTH DIMENSIONS ARE MAX PLASTIC BODY SIZE INCLUDING MOLD MISMATCH
3. DIMENSIONS IN MILLIMETERS

51-85064 *G

Figure 8. 40-pin QFN Package Outline

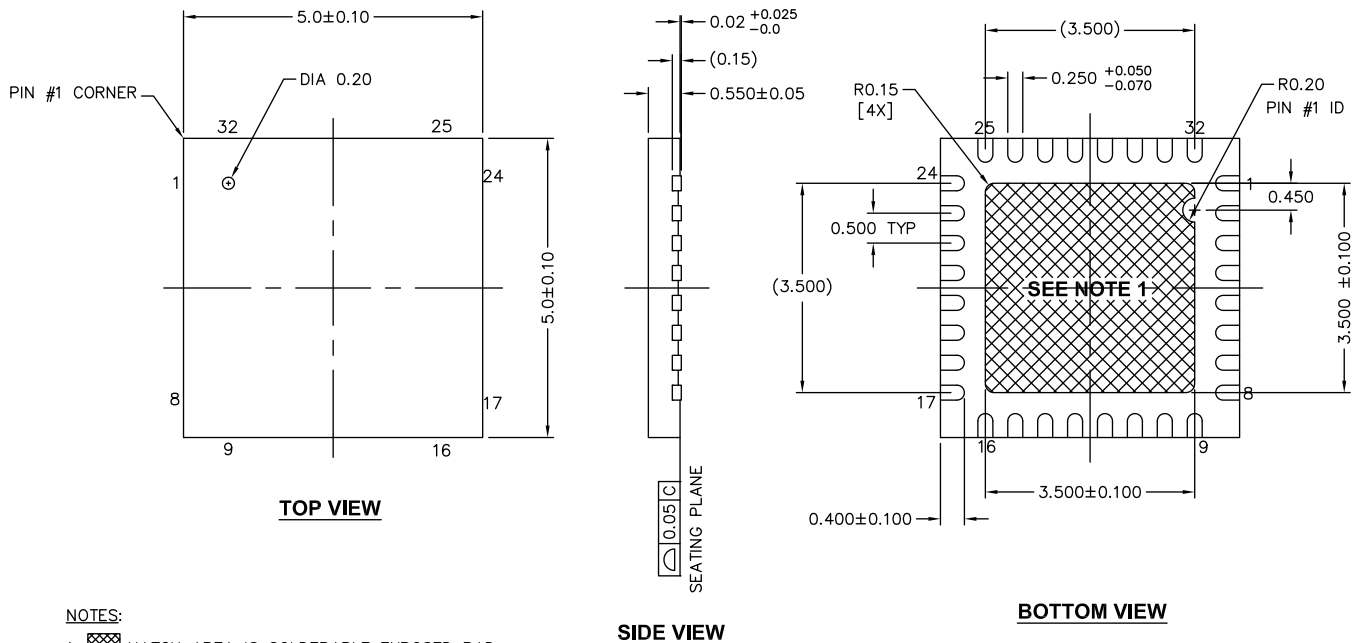


NOTES:

1.  HATCH AREA IS SOLDERABLE EXPOSED PAD
2. REFERENCE JEDEC # MO-248
3. PACKAGE WEIGHT: 68 ± 2 mg
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-80659 *A

Figure 9. 32-pin QFN Package Outline

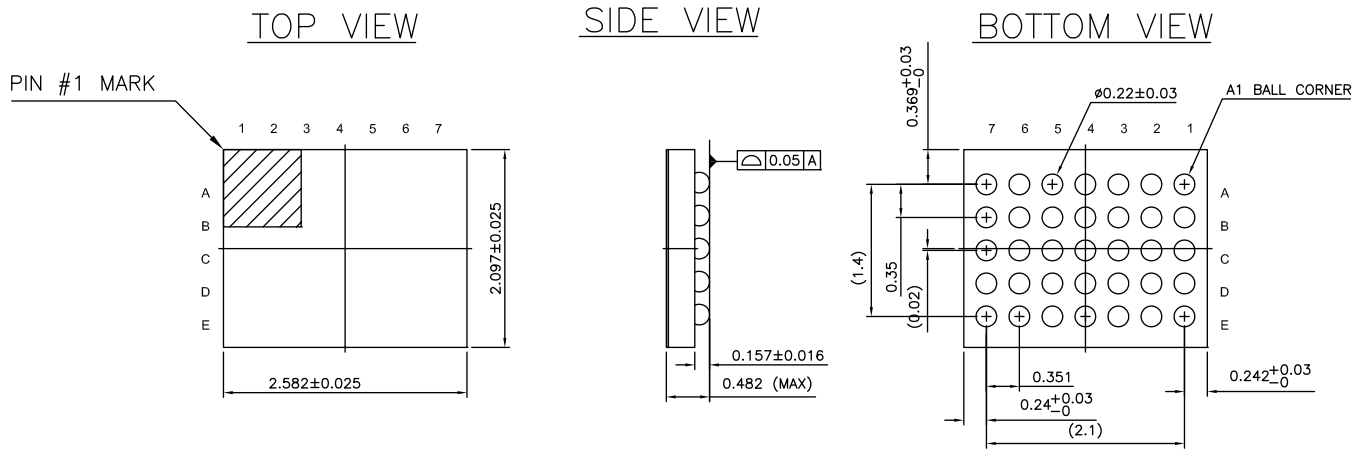


NOTES:

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

001-42168 *E

Figure 10. 35-Ball WLCSP Package Outline



ALL DIMENSIONS ARE IN MM
JEDEC Publication 95; Design Guide 4.18

002-09958 *C

Acronyms

Table 42. Acronyms Used in this Document

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

Table 42. Acronyms Used in this Document *(continued)*

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

Table 42. Acronyms Used in this Document *(continued)*

Acronym	Description
PC	program counter
PCB	printed circuit board
PGA	programmable gain amplifier
PHUB	peripheral hub
PHY	physical layer
PICU	port interrupt control unit
PLA	programmable logic array
PLD	programmable logic device, see also PAL
PLL	phase-locked loop
PMDD	package material declaration data sheet
POR	power-on reset
PRES	precise power-on reset
PRS	pseudo random sequence
PS	port read data register
PSoC®	Programmable System-on-Chip™
PSRR	power supply rejection ratio
PWM	pulse-width modulator
RAM	random-access memory
RISC	reduced-instruction-set computing
RMS	root-mean-square
RTC	real-time clock
RTL	register transfer language
RTR	remote transmission request
RX	receive
SAR	successive approximation register
SC/CT	switched capacitor/continuous time
SCL	I ² C serial clock
SDA	I ² C serial data
S/H	sample and hold
SINAD	signal to noise and distortion ratio
SIO	special input/output, GPIO with advanced features. See GPIO.
SOC	start of conversion
SOF	start of frame
SPI	Serial Peripheral Interface, a communications protocol
SR	slew rate
SRAM	static random access memory
SRES	software reset
SWD	serial wire debug, a test protocol

Table 42. Acronyms Used in this Document *(continued)*

Acronym	Description
SWV	single-wire viewer
TD	transaction descriptor, see also DMA
THD	total harmonic distortion
TIA	transimpedance amplifier
TRM	technical reference manual
TTL	transistor-transistor logic
TX	transmit
UART	Universal Asynchronous Transmitter Receiver, a communications protocol
UDB	universal digital block
USB	Universal Serial Bus
USBIO	USB input/output, PSoC pins used to connect to a USB port
VDAC	voltage DAC, see also DAC, IDAC
WDT	watchdog timer
WOL	write once latch, see also NVL
WRES	watchdog timer reset
XRES	external reset I/O pin
XTAL	crystal