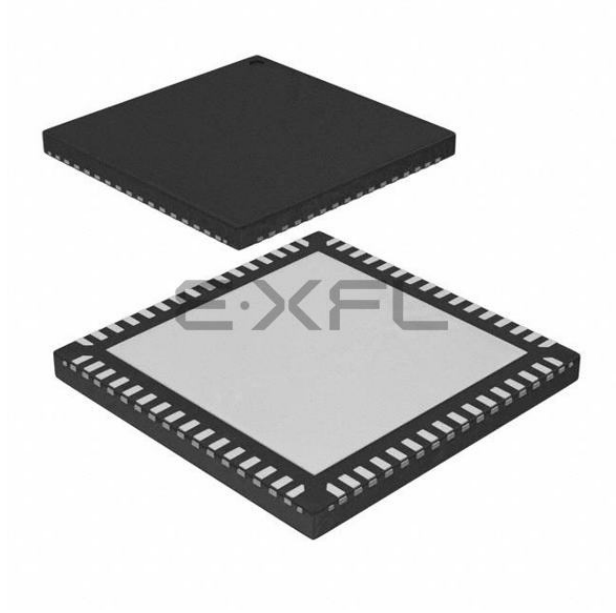

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What is "Embedded - Microcontrollers"?

"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	AVR
Core Size	8/16-Bit
Speed	32MHz
Connectivity	I²C, IrDA, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	50
Program Memory Size	192KB (96K x 16)
Program Memory Type	FLASH
EEPROM Size	2K x 8
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	1.6V ~ 3.6V
Data Converters	A/D 16x12b; D/A 2x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-QFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atxmega192a3-mh

7. Memories

7.1 Features

- **Flash Program Memory**
  - **One linear address space**
  - **In-System Programmable**
  - **Self-Programming and Bootloader support**
  - **Application Section for application code**
  - **Application Table Section for application code or data storage**
  - **Boot Section for application code or bootloader code**
  - **Separate lock bits and protection for all sections**
  - **Built in fast CRC check of a selectable flash program memory section**
- **Data Memory**
  - **One linear address space**
  - **Single cycle access from CPU**
  - **SRAM**
  - **EEPROM**
    - **Byte and page accessible**
    - **Optional memory mapping for direct load and store**
  - **I/O Memory**
    - **Configuration and Status registers for all peripherals and modules**
    - **16 bit-accessible General Purpose Register for global variables or flags**
  - **Bus arbitration**
    - **Safe and deterministic handling of CPU and DMA Controller priority**
  - **Separate buses for SRAM, EEPROM, I/O Memory and External Memory access**
    - **Simultaneous bus access for CPU and DMA Controller**
- **Production Signature Row Memory for factory programmed data**
  - **Device ID for each microcontroller device type**
  - **Serial number for each device**
  - **Oscillator calibration bytes**
  - **ADC, DAC and temperature sensor calibration data**
- **User Signature Row**
  - **One flash page in size**
  - **Can be read and written from software**
  - **Content is kept after chip erase**

7.2 Overview

The AVR architecture has two main memory spaces, the Program Memory and the Data Memory. In addition, the XMEGA A3 features an EEPROM Memory for non-volatile data storage. All three memory spaces are linear and require no paging. The available memory size configurations are shown in ”Ordering Information” on page 2. In addition each device has a Flash memory signature row for calibration data, device identification, serial number etc.

Non-volatile memory spaces can be locked for further write or read/write operations. This prevents unrestricted access to the application software.

15. I/O Ports

15.1 Features

- **Selectable input and output configuration for each pin individually**
- **Flexible pin configuration through dedicated Pin Configuration Register**
- **Synchronous and/or asynchronous input sensing with port interrupts and events**
  - **Sense both edges**
  - **Sense rising edges**
  - **Sense falling edges**
  - **Sense low level**
- **Asynchronous wake-up from all input sensing configurations**
- **Two port interrupts with flexible pin masking**
- **Highly configurable output driver and pull settings:**
  - **Totem-pole**
  - **Pull-up/-down**
  - **Wired-AND**
  - **Wired-OR**
  - **Bus-keeper**
  - **Inverted I/O**
- **Configuration of multiple pins in a single operation**
- **Read-Modify-Write (RMW) support**
- **Toggle/clear/set registers for Output and Direction registers**
- **Clock output on port pin**
- **Event Channel 0 output on port pin 7**
- **Mapping of port registers (virtual ports) into bit accessible I/O memory space**

15.2 Overview

The XMEGA A3 devices have flexible General Purpose I/O Ports. A port consists of up to 8 pins, ranging from pin 0 to pin 7. The ports implement several functions, including synchronous/asynchronous input sensing, pin change interrupts and configurable output settings. All functions are individual per pin, but several pins may be configured in a single operation.

15.3 I/O configuration

All port pins (Pn) have programmable output configuration. In addition, all port pins have an inverted I/O function. For an input, this means inverting the signal between the port pin and the pin register. For an output, this means inverting the output signal between the port register and the port pin. The inverted I/O function can be used also when the pin is used for alternate functions.

16. T/C - 16-bits Timer/Counter with PWM

16.1 Features

- **Seven 16-bit Timer/Counters**
  - **Four Timer/Counters of type 0**
  - **Three Timer/Counters of type 1**
- **Four Compare or Capture (CC) Channels in Timer/Counter 0**
- **Two Compare or Capture (CC) Channels in Timer/Counter 1**
- **Double Buffered Timer Period Setting**
- **Double Buffered Compare or Capture Channels**
- **Waveform Generation:**
  - **Single Slope Pulse Width Modulation**
  - **Dual Slope Pulse Width Modulation**
  - **Frequency Generation**
- **Input Capture:**
  - **Input Capture with Noise Cancelling**
  - **Frequency capture**
  - **Pulse width capture**
  - **32-bit input capture**
- **Event Counter with Direction Control**
- **Timer Overflow and Timer Error Interrupts and Events**
- **One Compare Match or Capture Interrupt and Event per CC Channel**
- **Supports DMA Operation**
- **Hi-Resolution Extension (Hi-Res)**
- **Advanced Waveform Extension (AWEX)**

16.2 Overview

XMEGA A3 has seven Timer/Counters, four Timer/Counter 0 and three Timer/Counter 1. The difference between them is that Timer/Counter 0 has four Compare/Capture channels, while Timer/Counter 1 has two Compare/Capture channels.

The Timer/Counters (T/C) are 16-bit and can count any clock, event or external input in the microcontroller. A programmable prescaler is available to get a useful T/C resolution. Updates of Timer and Compare registers are double buffered to ensure glitch free operation. Single slope PWM, dual slope PWM and frequency generation waveforms can be generated using the Compare Channels.

Through the Event System, any input pin or event in the microcontroller can be used to trigger input capture, hence no dedicated pins is required for this. The input capture has a noise canceller to avoid incorrect capture of the T/C, and can be used to do frequency and pulse width measurements.

A wide range of interrupt or event sources are available, including T/C Overflow, Compare match and Capture for each Compare/Capture channel in the T/C.

PORTC, PORTD and PORTE each has one Timer/Counter 0 and one Timer/Counter1. PORTF has one Timer/Counter 0. Notation of these are TCC0 (Time/Counter C0), TCC1, TCD0, TCD1, TCE0, TCE1 and TCF0, respectively.

19. RTC - Real-Time Counter

19.1 Features

- **16-bit Timer**
- **Flexible Tick resolution ranging from 1 Hz to 32.768 kHz**
- **One Compare register**
- **One Period register**
- **Clear timer on Overflow or Compare Match**
- **Overflow or Compare Match event and interrupt generation**

19.2 Overview

The XMEGA A3 includes a 16-bit Real-time Counter (RTC). The RTC can be clocked from an accurate 32.768 kHz Crystal Oscillator, the 32.768 kHz Calibrated Internal Oscillator, or from the 32 kHz Ultra Low Power Internal Oscillator. The RTC includes both a Period and a Compare register. For details, see Figure 19-1.

A wide range of Resolution and Time-out periods can be configured using the RTC. With a maximum resolution of 30.5 µs, time-out periods range up to 2000 seconds. With a resolution of 1 second, the maximum time-out period is over 18 hours (65536 seconds).

Figure 19-1. Real-time Counter overview

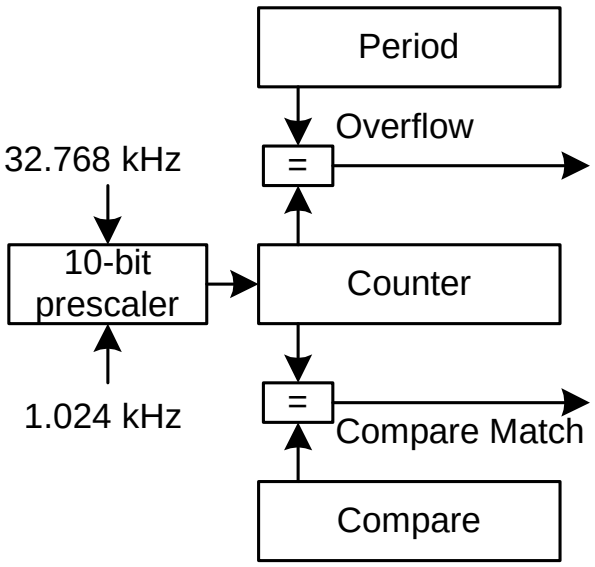


Table 30-6. Port F - Alternate functions

PORT F	PIN #	INTERRUPT	TCF0	USARTF0
PF0	46	SYNC	OC0A	
PF1	47	SYNC	OC0B	XCK0
PF2	48	SYNC/ASYNC	OC0C	RXD0
PF3	49	SYNC	OC0D	TXD0
PF4	50	SYNC		
PF5	51	SYNC		
PF6	54	SYNC		
PF7	55	SYNC		
GND	52			
VCC	53			

Table 30-7. Port R- Alternate functions

PORT R	PIN #	INTERRUPT	PROGR	XTAL
PDI	56		PDI_DATA	
$\overline{\text{RESET}}$	57		PDI_CLOCK	
PRO	58	SYNC		XTAL2
PR1	59	SYNC		XTAL1

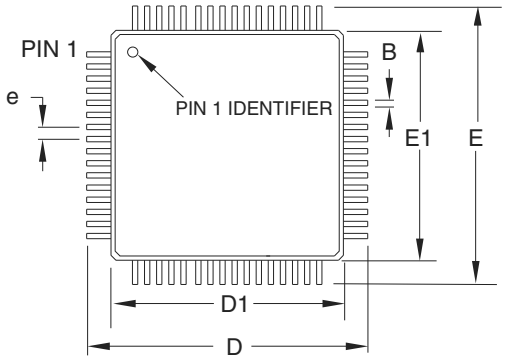
Table 30-8. ATxmega256/192/128/64A3 Boundary Scan Order

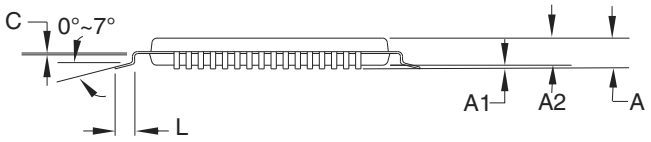
Bit Number	Signal Name	Module
149	PQ3.Bidir	PORT Q
148	PQ3.Control	
147	PQ2.Bidir	
146	PQ2.Control	
145	PQ1.Bidir	
144	PQ1.Control	
143	PQ0.Bidir	
142	PQ0.Control	
141	PK7.Bidir	PORT K
140	PK7.Control	
139	PK6.Bidir	
138	PK6.Control	
137	PK5.Bidir	
136	PK5.Control	
135	PK4.Bidir	
134	PK4.Control	
133	PK3.Bidir	
132	PK3.Control	
131	PK2.Bidir	
130	PK2.Control	
129	PK1.Bidir	
128	PK1.Control	
127	PK0.Bidir	
126	PK0.Control	

Bit Number	Signal Name	Module
125	PJ7.Bidir	PORT J
124	PJ7.Control	
123	PJ6.Bidir	
122	PJ6.Control	
121	PJ5.Bidir	
120	PJ5.Control	
119	PJ4.Bidir	
118	PJ4.Control	
117	PJ3.Bidir	
116	PJ3.Control	
115	PJ2.Bidir	
114	PJ2.Control	
113	PJ1.Bidir	
112	PJ1.Control	
111	PJ0.Bidir	
110	PJ0.Control	
109	PH7.Bidir	PORT H
108	PH7.Control	
107	PH6.Bidir	
106	PH6.Control	
105	PH5.Bidir	
104	PH5.Control	
103	PH4.Bidir	
102	PH4.Control	
101	PH3.Bidir	
100	PH3.Control	
99	PH2.Bidir	
98	PH2.Control	
97	PH1.Bidir	
96	PH1.Control	
95	PH0.Bidir	
94	PH0.Control	
93	PF7.Bidir	PORT F
92	PF7.Control	
91	PF6.Bidir	
90	PF6.Control	
89	PF5.Bidir	
88	PF5.Control	
87	PF4.Bidir	
86	PF4.Control	
85	PF3.Bidir	
84	PF3.Control	
83	PF2.Bidir	
82	PF2.Control	
81	PF1.Bidir	
80	PF1.Control	
79	PF0.Bidir	
78	PF0.Control	
77	PE7.Bidir	PORT E
76	PE7.Control	
75	PE6.Bidir	
74	PE6.Control	
73	PE5.Bidir	
72	PE5.Control	
71	PE4.Bidir	
70	PE4.Control	
69	PE3.Bidir	
68	PE3.Control	
67	PE2.Bidir	
66	PE2.Control	
65	PE1.Bidir	
64	PE1.Control	
63	PE0.Bidir	
62	PE0.Control	

33. Packaging information

33.1 64A





COMMON DIMENSIONS
(Unit of measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.20	
A1	0.05	–	0.15	
A2	0.95	1.00	1.05	
D	15.75	16.00	16.25	
D1	13.90	14.00	14.10	Note 2
E	15.75	16.00	16.25	
E1	13.90	14.00	14.10	Note 2
B	0.30	–	0.45	
C	0.09	–	0.20	
L	0.45	–	0.75	
e	0.80 TYP			

Notes:
1. This package conforms to JEDEC reference MS-026, Variation AEB.
2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is 0.25mm per side. Dimensions D1 and E1 are maximum plastic body size dimensions including mold mismatch.
3. Lead coplanarity is 0.10mm maximum.

2010-10-20

	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**64A,** 64-lead, 14 x 14mm Body Size, 1.0mm Body Thickness, 0.8mm Lead Pitch, Thin Profile Plastic Quad Flat Package (TQFP)	64A	C

34.11 POR Characteristics

Table 34-12. Power-on Reset Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{POT-}	POR threshold voltage falling V_{CC}	V_{CC} falls faster than 1V/ms	0.4	0.8		
		V_{CC} falls at 1V/ms or slower	0.8	1.3		V
V_{POT+}	POR threshold voltage rising V_{CC}			1.3	1.59	

34.12 Reset Characteristics

Table 34-13. Reset Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
	Minimum reset pulse width			90	1000	ns
	Reset threshold voltage	V_{CC} = 2.7 - 3.6V		0.45*V_{CC}		V
		V_{CC} = 1.6 - 2.7V		0.42*V_{CC}		

34.13 Oscillator Characteristics

Table 34-14. Internal 32.768kHz Oscillator Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
	Accuracy	T = 85°C, V_{CC} = 3V, After production calibration	-0.5		0.5	%

Table 34-15. Internal 2MHz Oscillator Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
	Accuracy	T = 85°C, V_{CC} = 3V, After production calibration	-1.5		1.5	%
	DFLL Calibration step size	T = 25°C, V_{CC} = 3V		0.15		

Table 34-16. Internal 32MHz Oscillator Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
	Accuracy	T = 85°C, V_{CC} = 3V, After production calibration	-1.5		1.5	%
	DFLL Calibration stepsize	T = 25°C, V_{CC} = 3V		0.2		

Table 34-17. Internal 32kHz, ULP Oscillator Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
	Output frequency 32kHz ULP OSC	T = 85°C, V_{CC} = 3.0V		26		kHz

35.3 Power-down Supply Current

Figure 35-15. Power-down Supply Current vs. Temperature

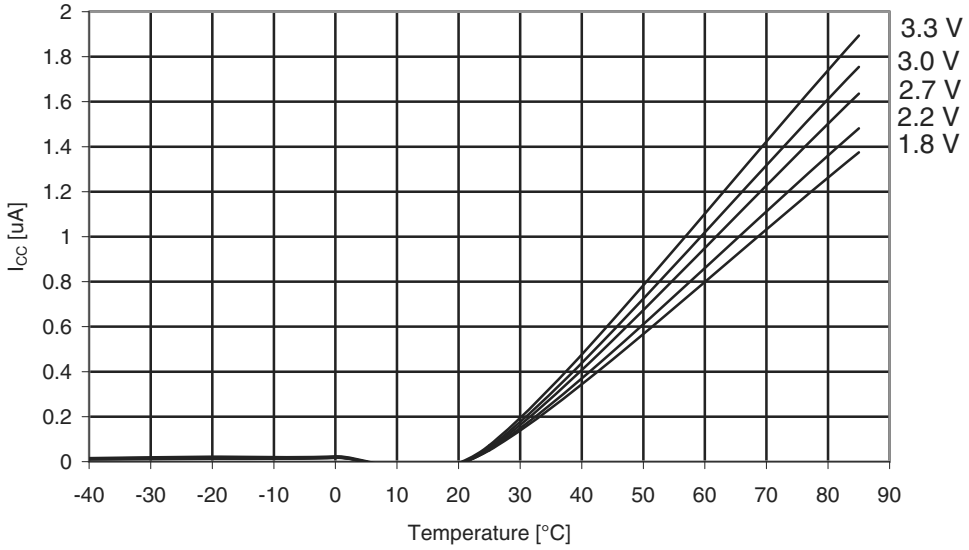
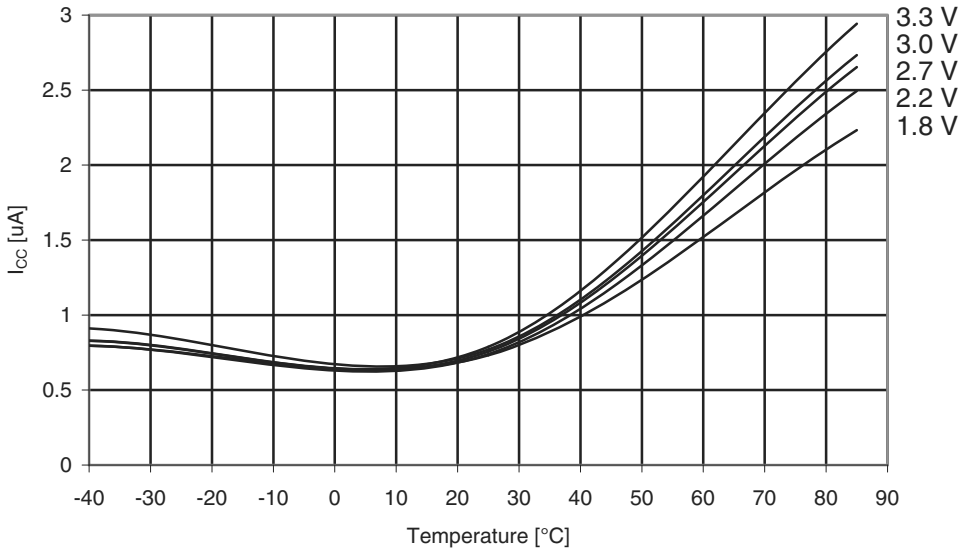


Figure 35-16. Power-down Supply Current vs. Temperature

With WDT and sampled BOD enabled.



35.7 Pin Thresholds and Hysteresis

Figure 35-27. I/O Pin Input Threshold Voltage vs. V_{CC}

V_{IH} - I/O Pin Read as "1"

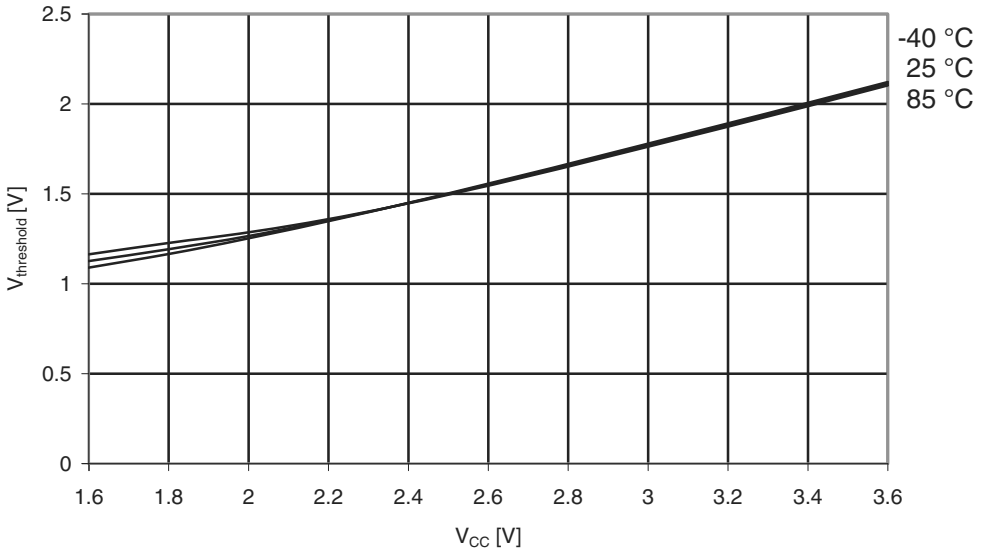


Figure 35-28. I/O Pin Input Threshold Voltage vs. V_{CC}

V_{IL} - I/O Pin Read as "0"

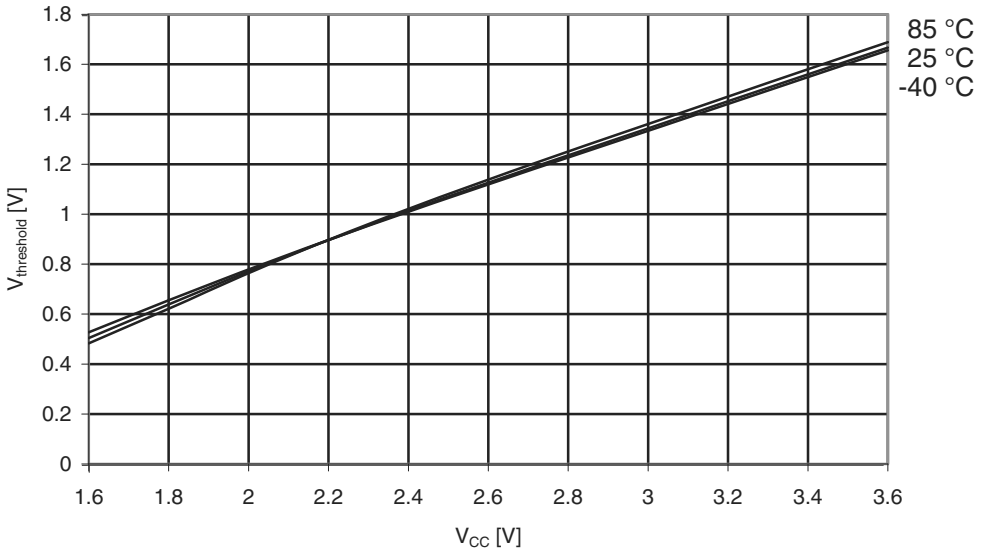
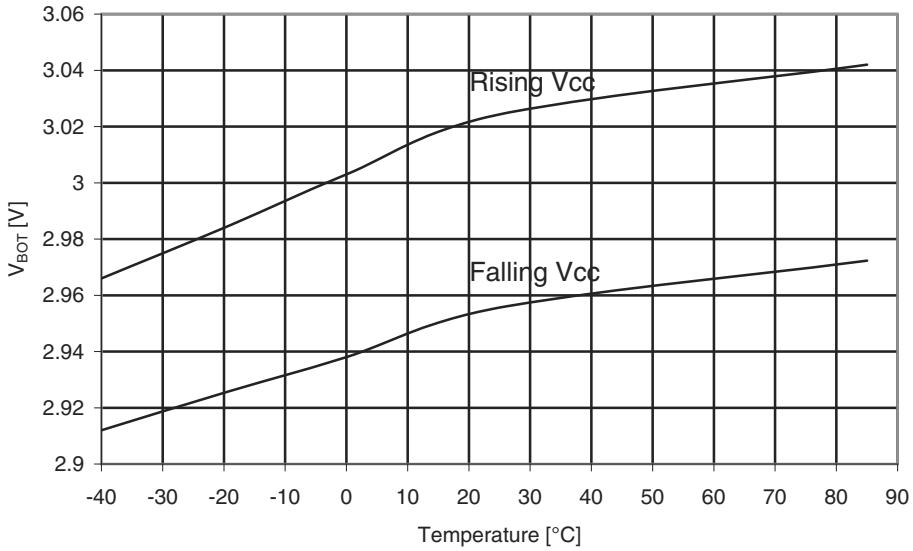


Figure 35-33. BOD Thresholds vs. Temperature

BOD Level = 2.9V

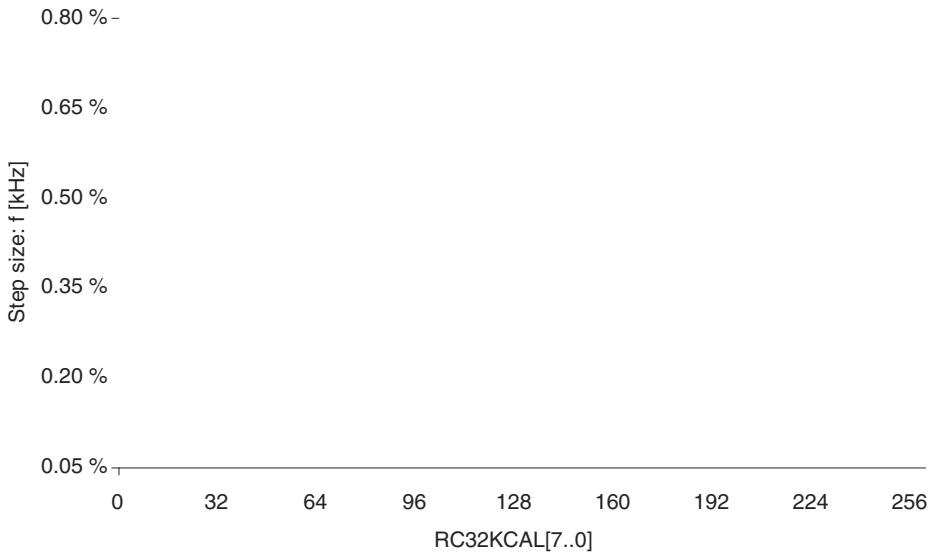


35.9 Oscillators and Wake-up Time

35.9.1 Internal 32.768 kHz Oscillator

Figure 35-34. Internal 32.768 kHz Oscillator Calibration Step Size

T = -40 to 85°C, V_{CC} = 3V



35.10 Module current consumption

Figure 35-39. AC current consumption vs. Vcc

Low-power Mode

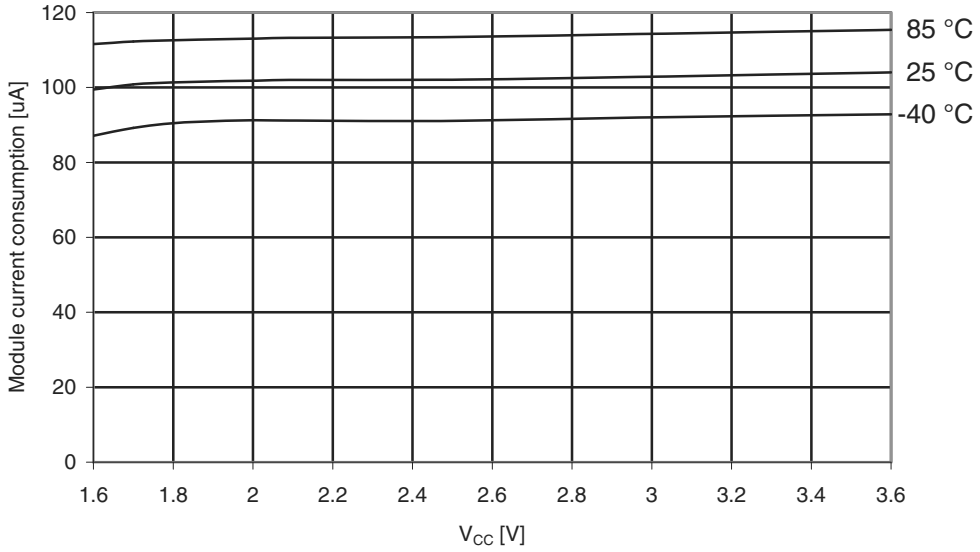
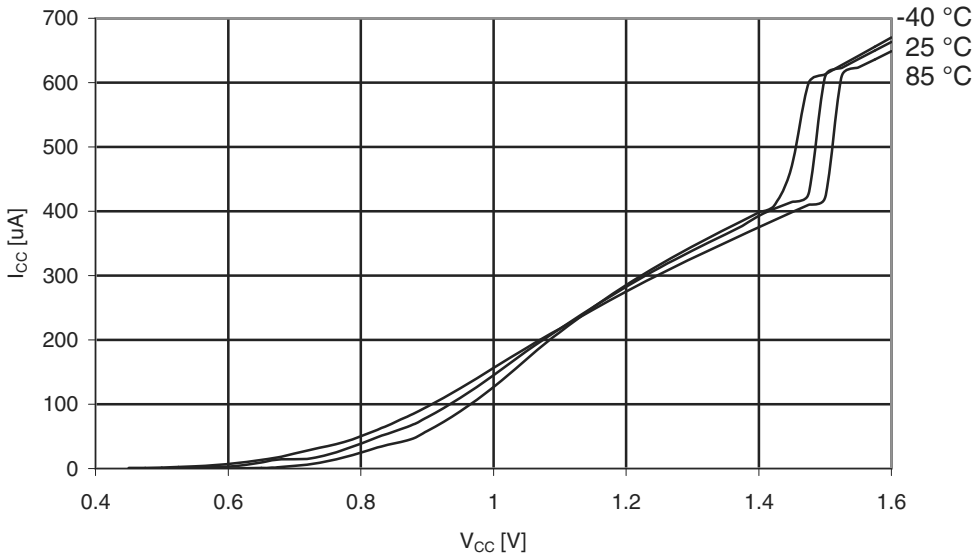


Figure 35-40. Power-up current consumption vs. Vcc



16. Pending full asynchronous pin change interrupts will not wake the device

Any full asynchronous pin-change Interrupt from pin 2, on any port, that is pending when the sleep instruction is executed, will be ignored until the device is woken from another source or the source triggers again. This applies when entering all sleep modes where the System Clock is stopped.

Problem fix/Workaround

None.

17. Pin configuration does not affect Analog Comparator output

The Output/Pull and inverted pin configuration does not affect the Analog Comparator output.

Problem fix/Workaround

None for Output/Pull configuration.

For inverted I/O, configure the Analog Comparator to give an inverted result (i.e. connect positive input to the negative AC input and vice versa), or use and external inverter to change polarity of Analog Comparator output.

18. NMI Flag for Crystal Oscillator Failure automatically cleared

NMI flag for Crystal Oscillator Failure (XOSCFDIF) will be automatically cleared when executing the NMI interrupt handler.

Problem fix/Workaround

This device revision has only one NMI interrupt source, so checking the interrupt source in software is not required.

19. Crystal start-up time required after power-save even if crystal is source for RTC

Even if 32.768 kHz crystal is used for RTC during sleep, the clock from the crystal will not be ready for the system before the specified start-up time. See "XOSCSEL[3:0]: Crystal Oscillator Selection" in XMEGA A Manual. If BOD is used in active mode, the BOD will be on during this period (0.5s).

Problem fix/Workaround

If faster start-up is required, go to sleep with internal oscillator as system clock.

20. RTC Counter value not correctly read after sleep

If the RTC is set to wake up the device on RTC Overflow and bit 0 of RTC CNT is identical to bit 0 of RTC PER as the device is entering sleep, the value in the RTC count register can not be read correctly within the first prescaled RTC clock cycle after wakeup. The value read will be the same as the value in the register when entering sleep.

The same applies if RTC Compare Match is used as wake-up source.

Problem fix/Workaround

Wait at least one prescaled RTC clock cycle before reading the RTC CNT value.

21. Pending asynchronous RTC-interrupts will not wake up device

Asynchronous Interrupts from the Real-Time-Counter that is pending when the sleep instruction is executed, will be ignored until the device is woken from another source or the source triggers again.

Problem fix/Workaround

None.

Problem fix/Workaround

Keep the amplified voltage output from the ADC gain stage below 2.4 V in order to get a correct result, or keep ADC voltage reference below 2.4 V.

5. **ADC Event on compare match non-functional**

   ADC signalling event will be given at every conversion complete even if Interrupt mode (INTMODE) is set to BELOW or ABOVE.

   Problem fix/Workaround

   Enable and use interrupt on compare match when using the compare function.

6. **Bandgap measurement with the ADC is non-functional when VCC is below 2.7V**

   The ADC can not be used to do bandgap measurements when VCC is below 2.7V.

   Problem fix/Workaround

   None.

7. **Accuracy lost on first three samples after switching input to ADC gain stage**

   Due to memory effect in the ADC gain stage, the first three samples after changing input channel must be disregarded to achieve 12-bit accuracy.

   Problem fix/Workaround

   Run three ADC conversions and discard these results after changing input channels to ADC gain stage.

8. **Configuration of PGM and CWCM not as described in XMEGA A Manual**

   Enabling Common Waveform Channel Mode will enable Pattern generation mode (PGM), but not Common Waveform Channel Mode.

   Enabling Pattern Generation Mode (PGM) and not Common Waveform Channel Mode (CWCM) will enable both Pattern Generation Mode and Common Waveform Channel Mode.

   Problem fix/Workaround

   Table 36-2. Configure PWM and CWCM according to this table:

PGM	CWCM	Description
0	0	PGM and CWCM disabled
0	1	PGM enabled
1	0	PGM and CWCM enabled
1	1	PGM enabled

9. **PWM is not restarted properly after a fault in cycle-by-cycle mode**

   When the AWeX fault restore mode is set to cycle-by-cycle, the waveform output will not return to normal operation at first update after fault condition is no longer present.

   Problem fix/Workaround

   Do a write to any AWeX I/O register to re-enable the output.

10. **BOD will be enabled after any reset**

    If any reset source goes active, the BOD will be enabled and keep the device in reset if the VCC voltage is below the programmed BOD level. During Power-On Reset, reset will not be released until VCC is above the programmed BOD level even if the BOD is disabled.

Problem fix/Workaround

None.

26. TWI Data Interrupt Flag erroneously read as set

When issuing the TWI slave response command CMD=0b11, it takes 1 Peripheral Clock cycle to clear the data interrupt flag (DIF). A read of DIF directly after issuing the command will show the DIF still set.

Problem fix/Workaround

Add one NOP instruction before checking DIF.

27. WDR instruction inside closed window will not issue reset

When a WDR instruction is execute within one ULP clock cycle after updating the window control register, the counter can be cleared without giving a system reset.

Problem fix/Workaround

Wait at least one ULP clock cycle before executing a WDR instruction.

16. Pending full asynchronous pin change interrupts will not wake the device

Any full asynchronous pin-change Interrupt from pin 2, on any port, that is pending when the sleep instruction is executed, will be ignored until the device is woken from another source or the source triggers again. This applies when entering all sleep modes where the System Clock is stopped.

Problem fix/Workaround

None.

17. Pin configuration does not affect Analog Comparator output

The Output/Pull and inverted pin configuration does not affect the Analog Comparator output.

Problem fix/Workaround

None for Output/Pull configuration.

For inverted I/O, configure the Analog Comparator to give an inverted result (i.e. connect positive input to the negative AC input and vice versa), or use and external inverter to change polarity of Analog Comparator output.

18. NMI Flag for Crystal Oscillator Failure automatically cleared

NMI flag for Crystal Oscillator Failure (XOSCFDIF) will be automatically cleared when executing the NMI interrupt handler.

Problem fix/Workaround

This device revision has only one NMI interrupt source, so checking the interrupt source in software is not required.

19. Crystal start-up time required after power-save even if crystal is source for RTC

Even if 32.768 kHz crystal is used for RTC during sleep, the clock from the crystal will not be ready for the system before the specified start-up time. See "XOSCSEL[3:0]: Crystal Oscillator Selection" in XMEGA A Manual. If BOD is used in active mode, the BOD will be on during this period (0.5s).

Problem fix/Workaround

If faster start-up is required, go to sleep with internal oscillator as system clock.

20. RTC Counter value not correctly read after sleep

If the RTC is set to wake up the device on RTC Overflow and bit 0 of RTC CNT is identical to bit 0 of RTC PER as the device is entering sleep, the value in the RTC count register can not be read correctly within the first prescaled RTC clock cycle after wakeup. The value read will be the same as the value in the register when entering sleep.

The same applies if RTC Compare Match is used as wake-up source.

Problem fix/Workaround

Wait at least one prescaled RTC clock cycle before reading the RTC CNT value.

21. Pending asynchronous RTC-interrupts will not wake up device

Asynchronous Interrupts from the Real-Time-Counter that is pending when the sleep instruction is executed, will be ignored until the device is woken from another source or the source triggers again.

Problem fix/Workaround

None.

Problem fix/Workaround

None.

26. TWI Data Interrupt Flag erroneously read as set

When issuing the TWI slave response command CMD=0b11, it takes 1 Peripheral Clock cycle to clear the data interrupt flag (DIF). A read of DIF directly after issuing the command will show the DIF still set.

Problem fix/Workaround

Add one NOP instruction before checking DIF.

27. WDR instruction inside closed window will not issue reset

When a WDR instruction is execute within one ULP clock cycle after updating the window control register, the counter can be cleared without giving a system reset.

Problem fix/Workaround

Wait at least one ULP clock cycle before executing a WDR instruction.

36.2.3 rev. A

Not sampled.

37. Datasheet Revision History

Please note that the referring page numbers in this section are referred to this document. The referring revision in this section are referring to the document revision.

37.1 8068U – 06/13

1. Not recommended for new designs - Use XMEGA A3U series.

37.2 8068T – 12/10

1. Datasheet status changed to complete: Preliminary removed from the front page.
2. Updated all tables in the “Electrical Characteristics” .
3. Updated ”Packaging information” on page 61.
4. Replaced Table 34-11 on page 69
5. Replaced Table 34-18 on page 71 and added the figure ”TOSC input capacitance” on page 71
6. Added ERRATA “rev. E” .
7. Added ERRATA “rev. B” .
8. Updated ERRATA for ADC (ADC has increased INL error for some operating conditions).
9. Updated the last page by Atmel new Brand Style Guide.

37.3 8068S – 09/10

10. Updated ”Errata” on page 93.

37.4 8068R – 08/10

1. Updated the Footnote 3 of ”Ordering Information” on page 2.
2. Updated Footnote 2 of Figure 2-1 on page 3.
3. Updated ”Data Memory Map (Hexadecimal address)” on page 11. 192A3 has 2 KB EEPROM.
4. Updated ”Features” on page 27. Event Channel 0 output on port pin 7.
5. Updated ”Absolute Maximum Ratings*” on page 63 by adding Icc for Flash/EEPROM Programming.
6. Added AVCC in ”ADC Characteristics” on page 67.
7. Updated Start up time in ”ADC Characteristics” on page 67.

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