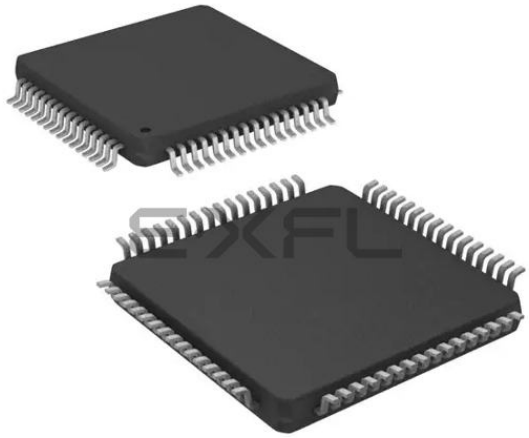

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Applications of "Embedded - Microcontrollers"

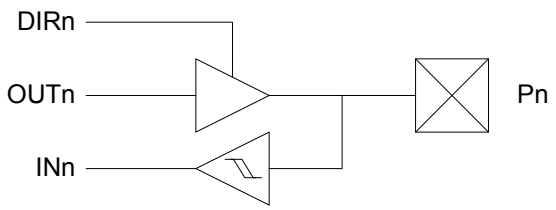
Details	
Product Status	Active
Core Processor	AVR
Core Size	8/16-Bit
Speed	32MHz
Connectivity	I²C, IrDA, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	50
Program Memory Size	32KB (16K x 16)
Program Memory Type	FLASH
EEPROM Size	1K x 8
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	1.6V ~ 3.6V
Data Converters	A/D 16x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-TQFP
Supplier Device Package	64-TQFP (14x14)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atxmega32d3-au

14.3 Output Driver

All port pins (Pn) have programmable output configuration.

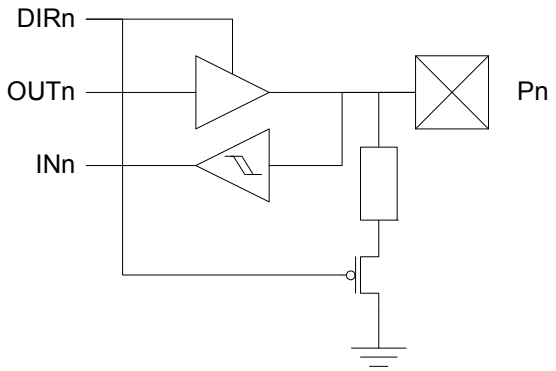
14.3.1 Push-pull

Figure 14-1. I/O Configuration - Totem-pole



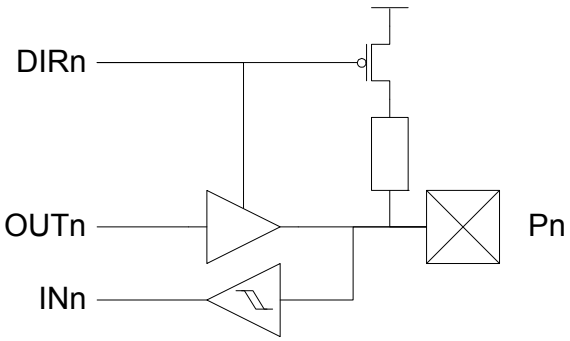
14.3.2 Pull-down

Figure 14-2. I/O Configuration - Totem-pole with Pull-down (on input)



14.3.3 Pull-up

Figure 14-3. I/O Configuration - Totem-pole with Pull-up (on input)



28. Pinout and Pin Functions

The device pinout is shown in “Pinout/block Diagram” on page 5. In addition to general purpose I/O functionality, each pin can have several alternate functions. This will depend on which peripheral is enabled and connected to the actual pin. Only one of the pin functions can be used at time.

28.1 Alternate Pin Function Description

The tables below show the notation for all pin functions available and describe its function.

28.1.1 Operation/power Supply

V_{CC}	Digital supply voltage
AV_{CC}	Analog supply voltage
GND	Ground

28.1.2 Port Interrupt Functions

SYNC	Port pin with full synchronous and limited asynchronous interrupt function
ASYNC	Port pin with full synchronous and full asynchronous interrupt function

28.1.3 Analog Functions

ACn	Analog comparator input pin n
ACnOUT	Analog comparator n output
ADCn	Analog to digital converter input pin n
A_{REF}	Analog reference input pin

28.1.4 Timer/counter and AWEX Functions

OCnxLS	Output compare channel x low side for Timer/Counter n
OCnxHS	Output compare channel x high side for Timer/Counter n

Table 32-10. Accuracy Characteristics

Symbol	Parameter	Condition [2]		Min.	Typ.	Max.	Units
RES	Resolution	12-bit resolution	Differential	8	12	12	Bits
			Single ended signed	7	11	11	
			Single ended unsigned	8	12	12	
INL [1]	Integral non-linearity	Differential mode	16ksps, V_{REF} = 3V		0.5	1	lsb
			16ksps, all V_{REF}		0.8	2	
			300ksps, V_{REF} = 3V		0.6	1	
			300ksps, all V_{REF}		1	2	
		Single ended unsigned mode	16ksps, V_{REF} = 3.0V		0.5	1	
			16ksps, all V_{REF}		1.3	2	
DNL [1]	Differential non-linearity	Differential mode	16ksps, V_{REF} = 3V		0.3	1	
			16ksps, all V_{REF}		0.5	1	
			300ksps, V_{REF} = 3V		0.3	1	
			300ksps, all V_{REF}		0.5	1	
		Single ended unsigned mode	16ksps, V_{REF} = 3V		0.6	1	
			16ksps, all V_{REF}		0.6	1	
	Offset error	Differential mode	300ksps, V_{REF} = 3V		-7		mV
			Temperature drift, V_{REF} = 3V		0.01		mV/K
			Operating voltage drift		0.16		mV/V
	Gain error	Differential mode	External reference		-5		mV
			AV_{CC}/1.6		-5		
			AV_{CC}/2.0		-6		
			Bandgap		±10		
			Temperature drift		0.02		mV/K
			Operating voltage drift		2		mV/V
	Gain error	Single ended unsigned mode	External reference		-8		mV
			AV_{CC}/1.6		-8		
			AV_{CC}/2.0		-8		
			Bandgap		±10		
			Temperature drift		0.03		mV/K
			Operating voltage drift		2		mV/V

Notes:
1. Maximum numbers are based on characterisation and not tested in production, and valid for 5% to 95% input voltage range.
2. Unless otherwise noted all linearity, offset and gain error numbers are valid under the condition that external VREF is used.

32.1.14 SPI Characteristics

Figure 32-5. SPI Timing Requirements in Master Mode

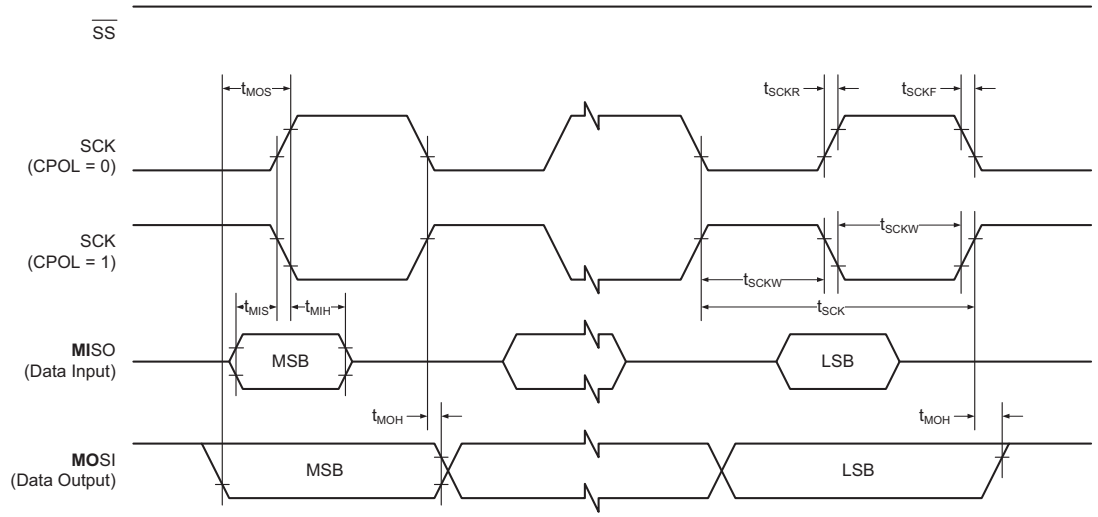


Figure 32-6. SPI Timing Requirements in Slave Mode

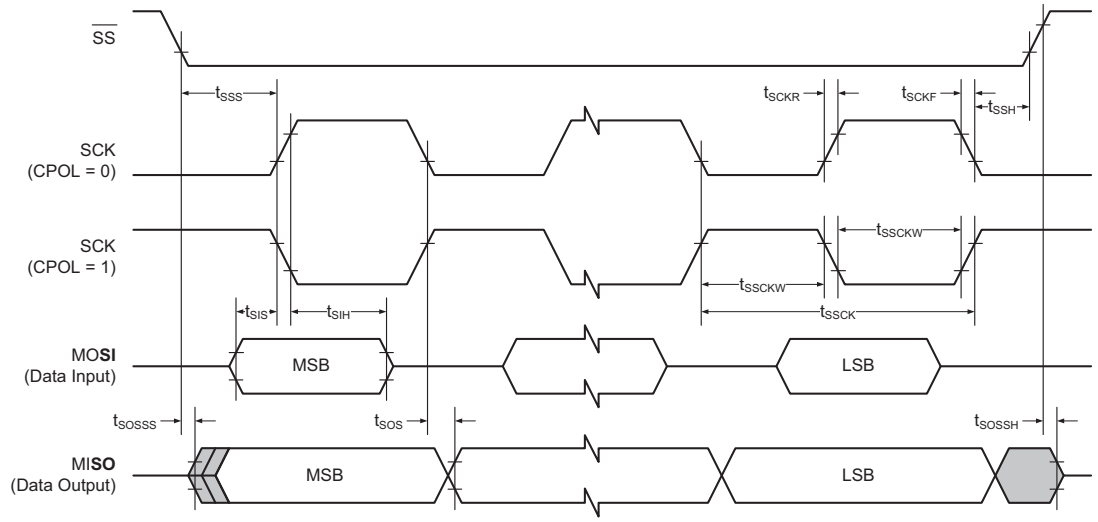


Table 32-34. Current Consumption for Modules and Peripherals

Symbol	Parameter	Condition [1]			Min.	Typ.	Max.	Units
I_{CC}	ULP oscillator					0.9		µA
	32.768kHz int. oscillator					29		
	2MHz int. oscillator					82		
		DFLL enabled with 32.768kHz int. osc. as reference				114		
	32MHz int. oscillator					250		
		DFLL enabled with 32.768kHz int. osc. as reference				400		
	PLL	20× multiplication factor, 32MHz int. osc. DIV4 as reference				300		
	Watchdog timer					1.0		
	BOD	Continuous mode				140		
		Sampled mode, includes ULP oscillator				1.4		
	Internal 1.0V reference					180		
	Temperature sensor					175		
	ADC	16ksps V_{REF} = Ext. ref.				1.23		mA
			CURRLIMIT = LOW			1.1		
			CURRLIMIT = MEDIUM			0.98		
			CURRLIMIT = HIGH			0.87		
		75ksps V_{REF} = Ext. ref.	CURRLIMIT = LOW			1.7		
		300ksps V_{REF} = Ext. ref.				3.1		
	USART	Rx and Tx enabled, 9600 BAUD				9.7		µA
	Flash memory and EEPROM programming					5		mA

Note: 1. All parameters measured as the difference in current consumption between module enabled and disabled. All data at V_{CC} = 3.0V, Clk_{SYS} = 1MHz external clock without prescaling, T = 25°C unless other conditions are given.

Table 32-68. Accuracy Characteristics

Symbol	Parameter	Condition [2]		Min.	Typ.	Max.	Units
RES	Resolution	12-bit resolution	Differential	8	12	12	Bits
			Single ended signed	7	11	11	
			Single ended unsigned	8	12	12	
INL [1]	Integral non-linearity	Differential mode	16ksps, V_{REF} = 3V		0.5	1	lsb
			16ksps, all V_{REF}		0.8	2	
			300ksps, V_{REF} = 3V		0.6	1	
			300ksps, all V_{REF}		1.0	2	
		Single ended unsigned mode	16ksps, V_{REF} = 3.0V		0.5	1	
			16ksps, all V_{REF}		1.3	2	
DNL [1]	Differential non-linearity	Differential mode	16ksps, V_{REF} = 3V		0.3	1	lsb
			16ksps, all V_{REF}		0.5	1	
			300ksps, V_{REF} = 3V		0.3	1	
			300ksps, all V_{REF}		0.5	1	
		Single ended unsigned mode	16ksps, V_{REF} = 3.0V		0.6	1	
			16ksps, all V_{REF}		0.6	1	
	Offset error	Differential mode	300ksps, V_{REF} = 3V		-7		mV
			Temperature drift, V_{REF} = 3V		0.01		mV/K
			Operating voltage drift		0.16		mV/V
	Gain error	Differential mode	External reference		-5		mV
			AV_{CC}/1.6		-5		
			AV_{CC}/2.0		-6		
			Bandgap		±10		
			Temperature drift		0.02		mV/K
			Operating voltage drift		2		mV/V
	Gain error	Single ended unsigned mode	External reference		-8		mV
			AV_{CC}/1.6		-8		
			AV_{CC}/2.0		-8		
			Bandgap		±10		
			Temperature drift		0.03		mV/K
			Operating voltage drift		2		mV/V

Notes:
1. Maximum numbers are based on characterization and not tested in production and valid for 5% to 95% input voltage range.
2. Unless otherwise noted all linearity, offset and gain error numbers are valid under the condition that external V_{REF} is used.

32.3.14 SPI Characteristics

Figure 32-19.SPI Timing Requirements in Master Mode

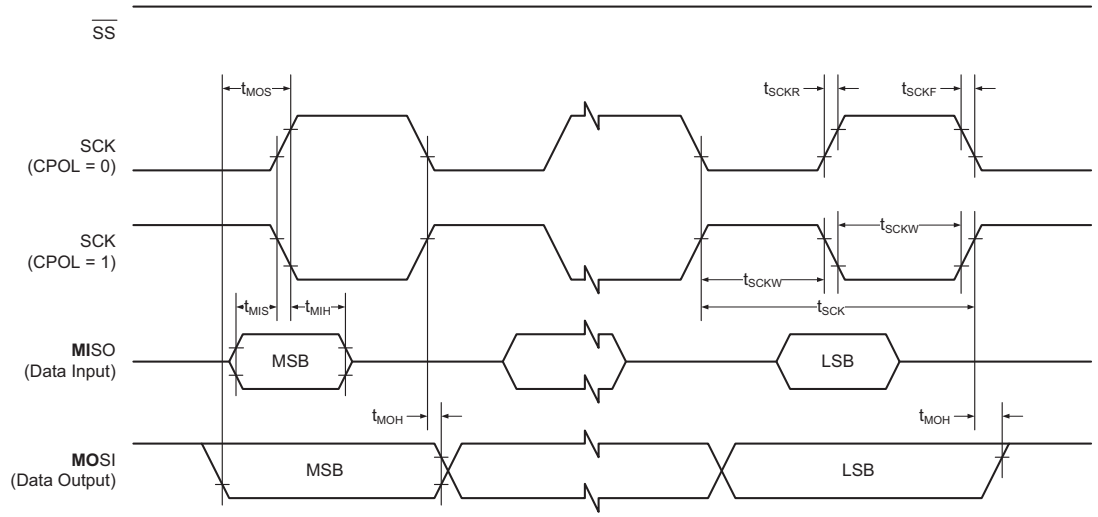
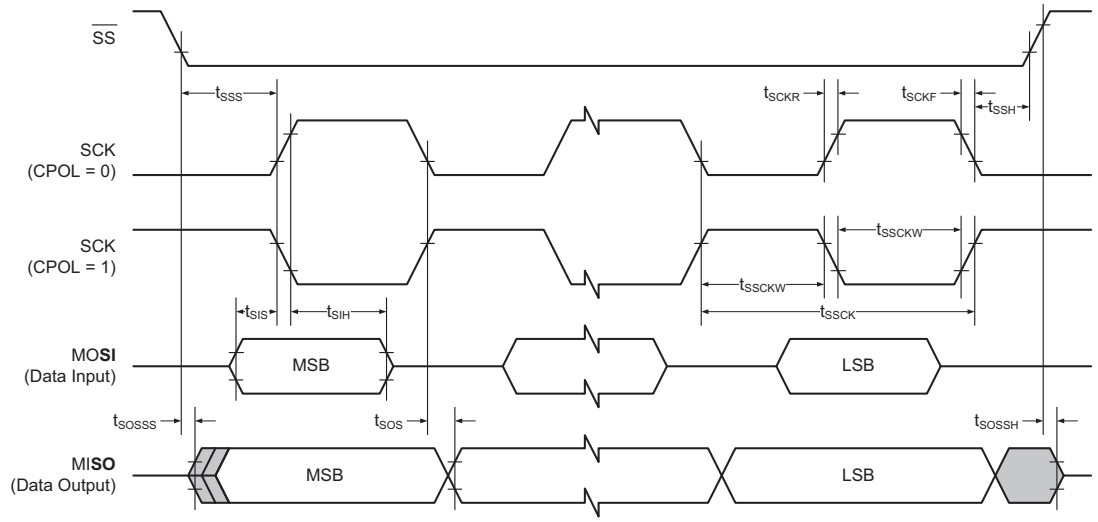


Figure 32-20.SPI Timing Requirements in Slave Mode



Symbol	Parameter	Condition		Min.	Typ.	Max.	Units
C_{XTAL1}	Parasitic capacitance XTAL1 pin				5.9		pF
C_{XTAL2}	Parasitic capacitance XTAL2 pin				8.3		
C_{LOAD}	Parasitic capacitance load				3.5		

Notes: 1. Numbers for negative impedance are not tested in production but guaranteed from design and characterization.

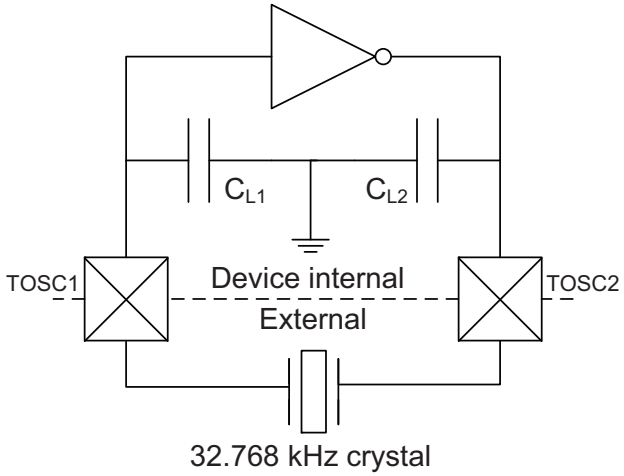
32.4.13.8 External 32.768kHz Crystal Oscillator and TOSC Characteristics

Table 32-114. External 32.768kHz Crystal Oscillator and TOSC Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
ESR/R1	Recommended crystal equivalent series resistance (ESR)	Crystal load capacitance 6.5pF			60	kΩ
		Crystal load capacitance 9.0pF			35	
		Crystal load capacitance 12pF			28	
C_{TOSC1}	Parasitic capacitance TOSC1 pin			3.5		pF
C_{TOSC2}	Parasitic capacitance TOSC2 pin			3.5		
	Recommended safety factor	Capacitance load matched to crystal specification	3			

Note: See Figure 32-25 for definition.

Figure 32-25. TOSC Input Capacitance



The parasitic capacitance between the TOSC pins is C_{L1} + C_{L2} in series as seen from the crystal when oscillating without external capacitors.

Figure 33-82. Idle Mode Supply Current vs. V_{CC}

f_{SYS} = 1MHz external clock

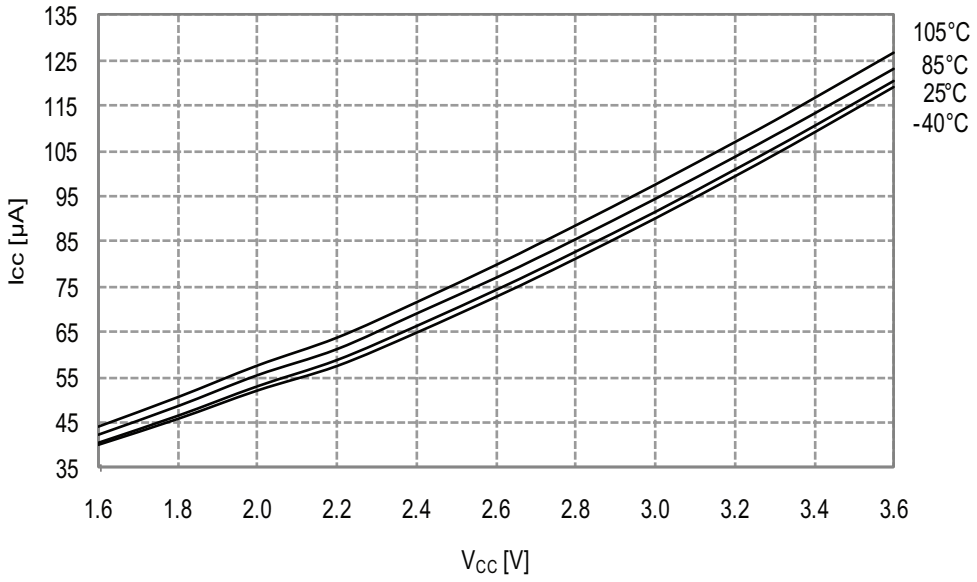
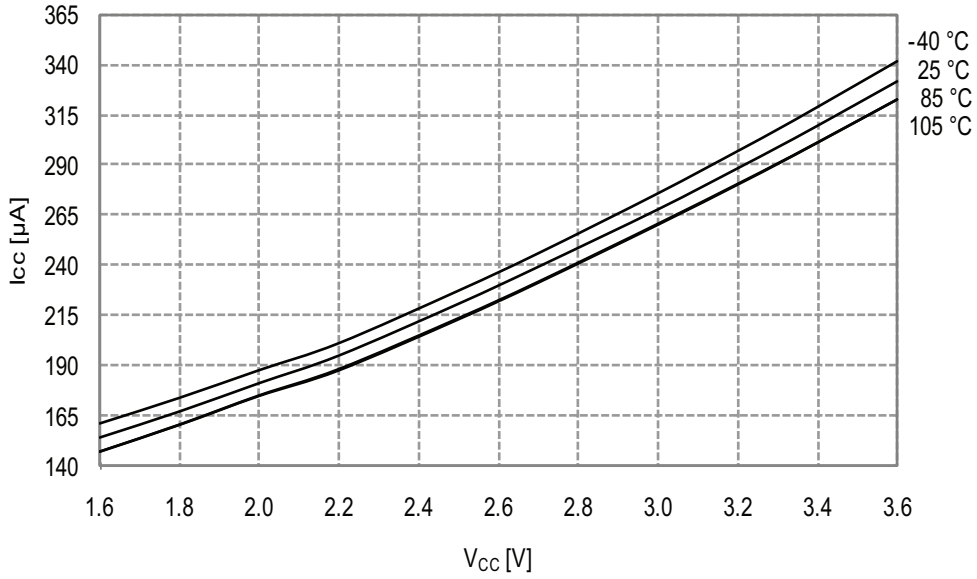


Figure 33-83. Idle Mode Supply Current vs. V_{CC}

f_{SYS} = 2MHz internal oscillator



33.2.2 I/O Pin Characteristics

33.2.2.1 Pull-up

Figure 33-90. I/O Pin Pull-up Resistor Current vs. Input Voltage

V_{CC} = 1.8V

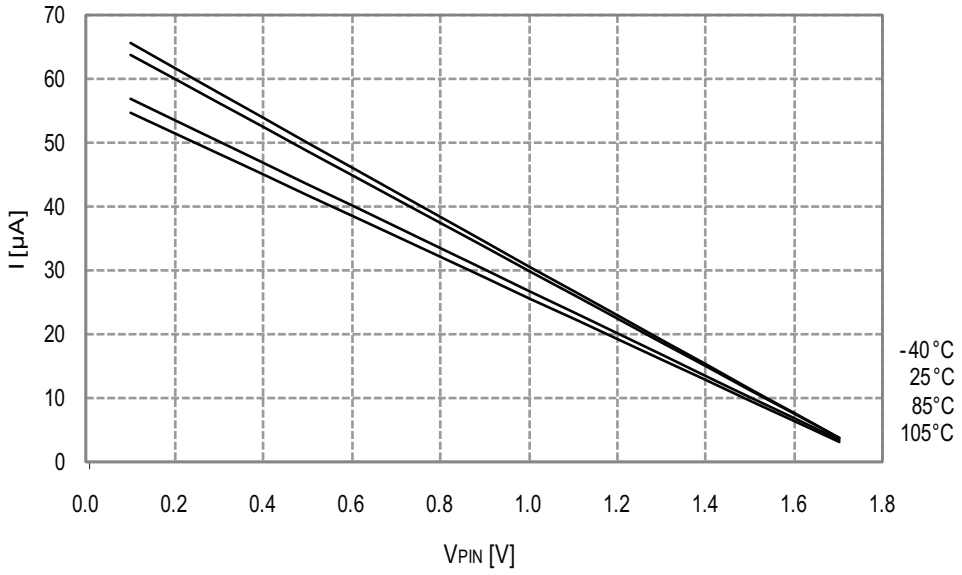


Figure 33-91. I/O Pin Pull-up Resistor Current vs. Input Voltage

V_{CC} = 3.0V

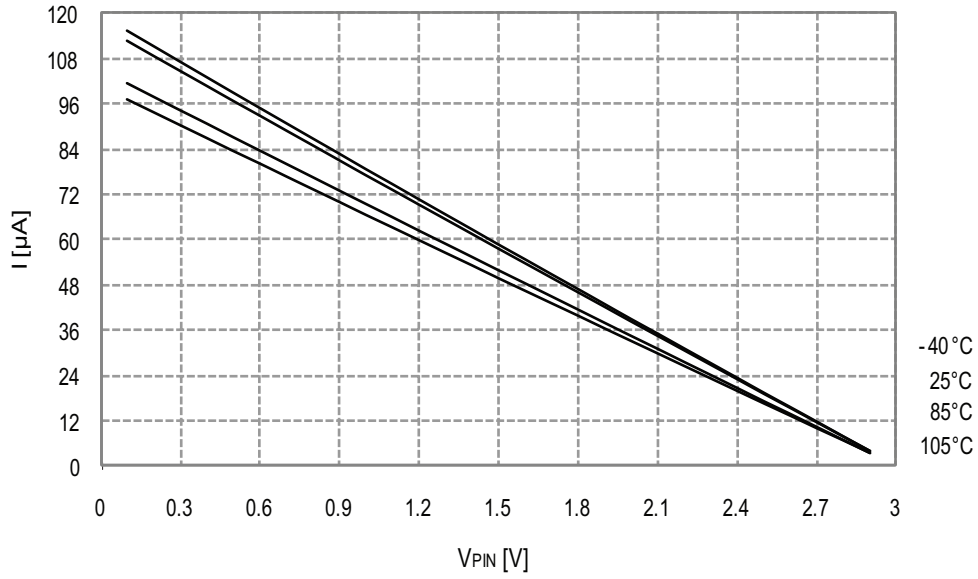


Figure 33-108. Gain Error vs. V_{REF}

T = 25°C, V_{CC} = 3.6V, ADC sample rate = 300ksps

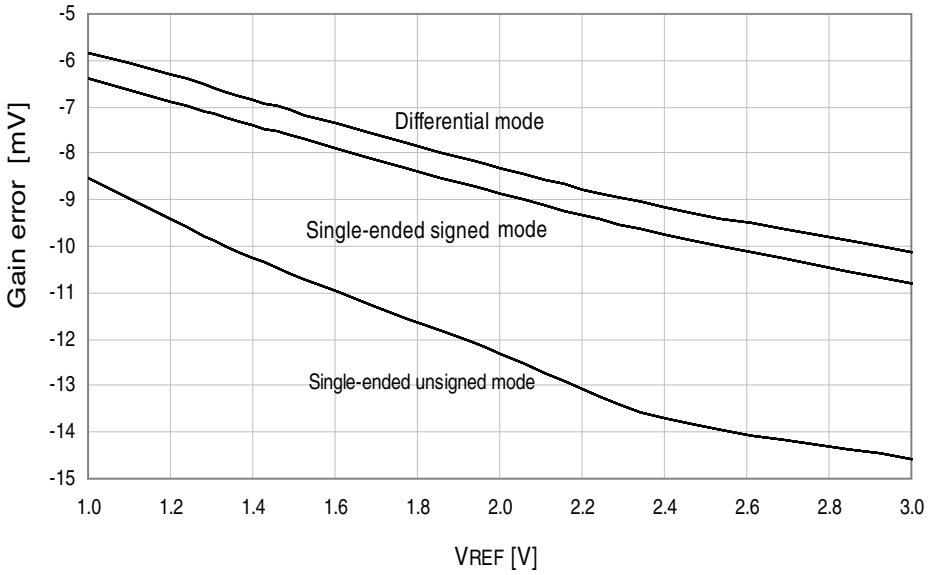


Figure 33-109. Gain Error vs. V_{CC}

T = 25°C, V_{REF} = external 1.0V, ADC sample rate = 300ksps

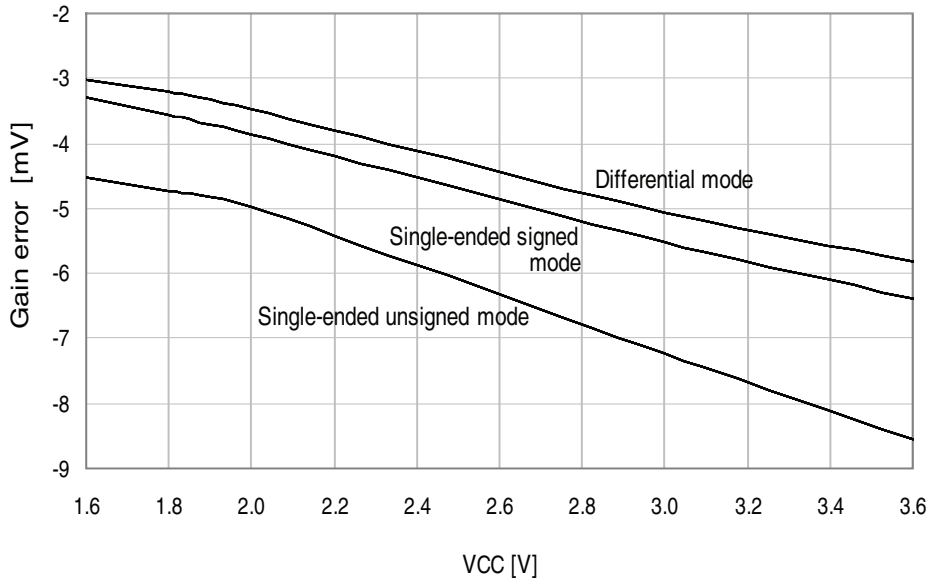


Figure 33-136. 32MHz Internal Oscillator CALA Calibration Step Size

T = 105°C, V_{CC} = 3.0V

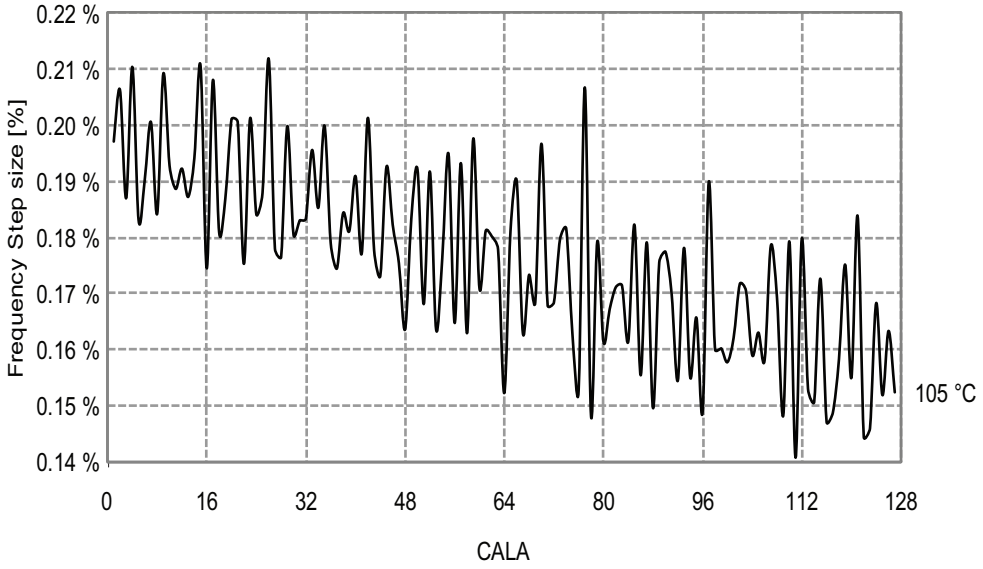


Figure 33-137. 32MHz Internal Oscillator Frequency vs. CALB Calibration Value

V_{CC} = 3.0V

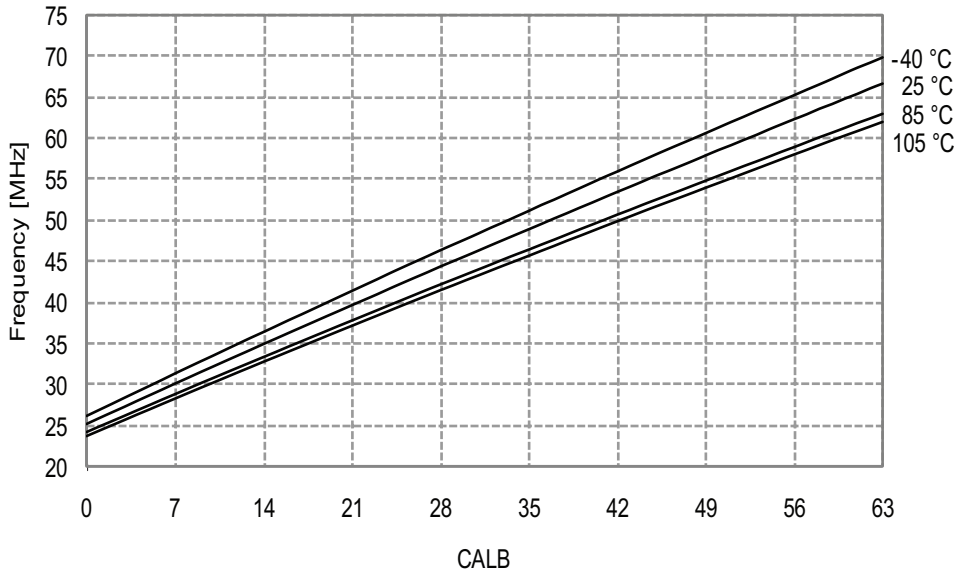


Figure 33-155. Idle Mode Supply Current vs. V_{CC}

f_{SYS} = 32MHz internal oscillator prescaled to 8MHz

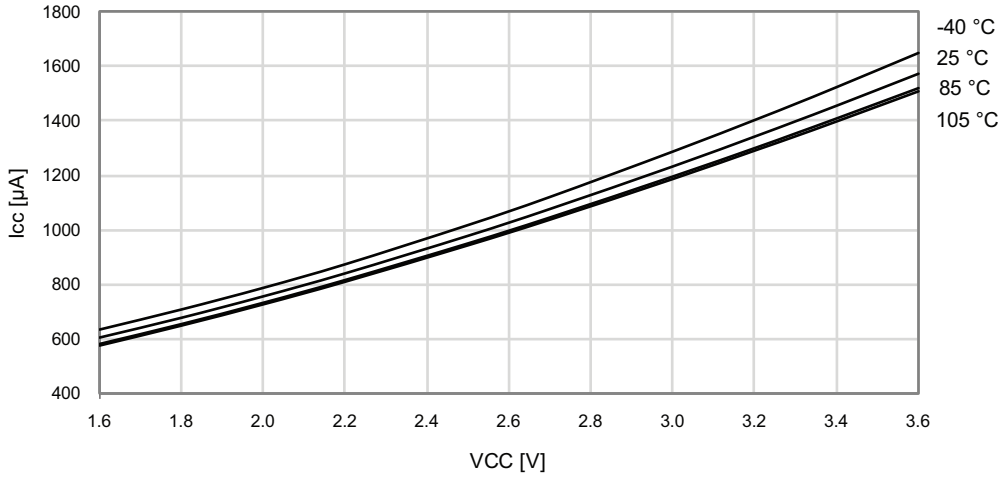
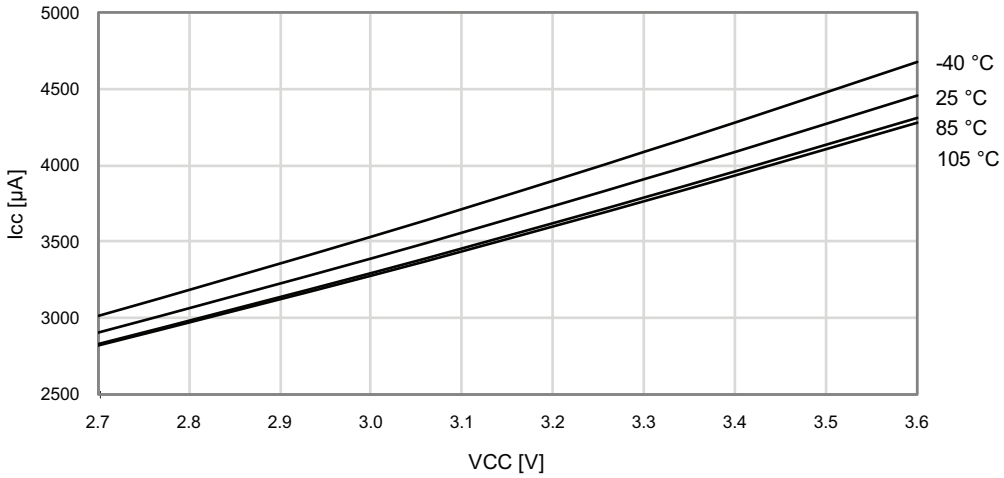


Figure 33-156. Idle Mode Current vs. V_{CC}

f_{SYS} = 32MHz internal oscillator



33.4 Atmel ATxmega192D3

33.4.1 Current Consumption

33.4.1.1 Active Mode Supply Current

Figure 33-213.Active Supply Current vs. Frequency

f_{SYS} = 0 - 1MHz external clock, T = 25°C

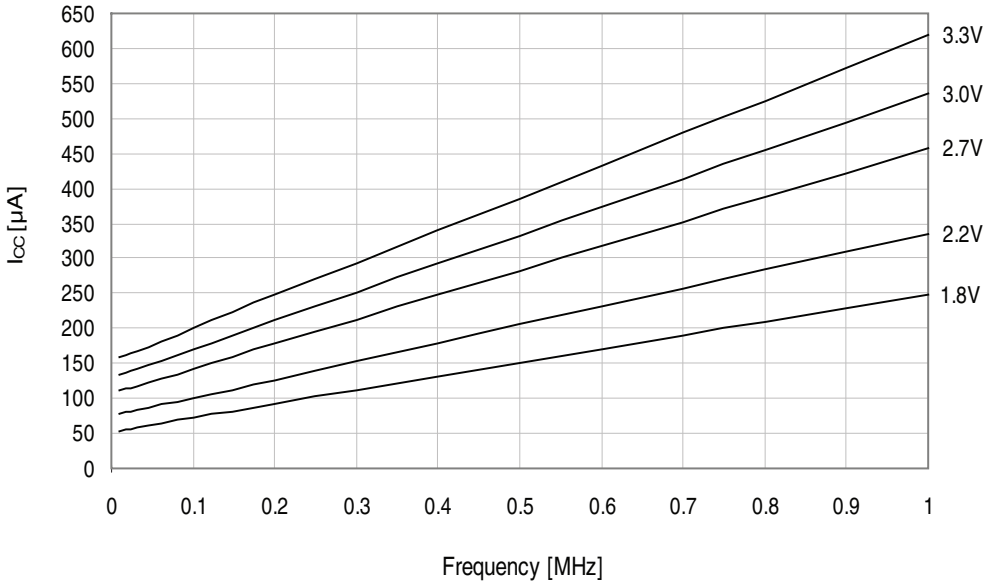
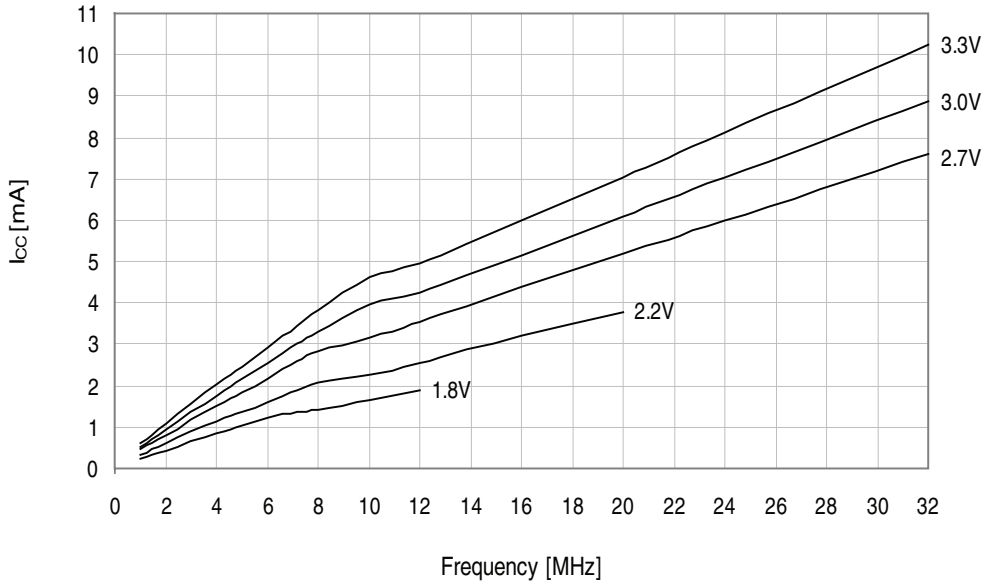


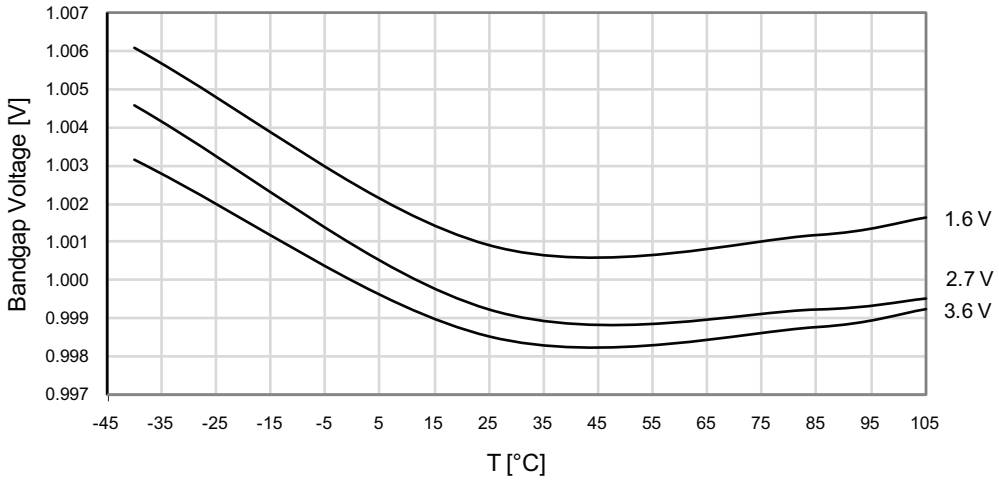
Figure 33-214.Active Supply Current vs. Frequency

f_{SYS} = 1 - 32MHz external clock, T = 25°C



33.4.5 Internal 1.0V Reference Characteristics

Figure 33-257.ADC Internal 1.0V Reference vs. Temperature



33.4.6 BOD Characteristics

Figure 33-258.BOD Thresholds vs. Temperature

BOD level = 1.6V

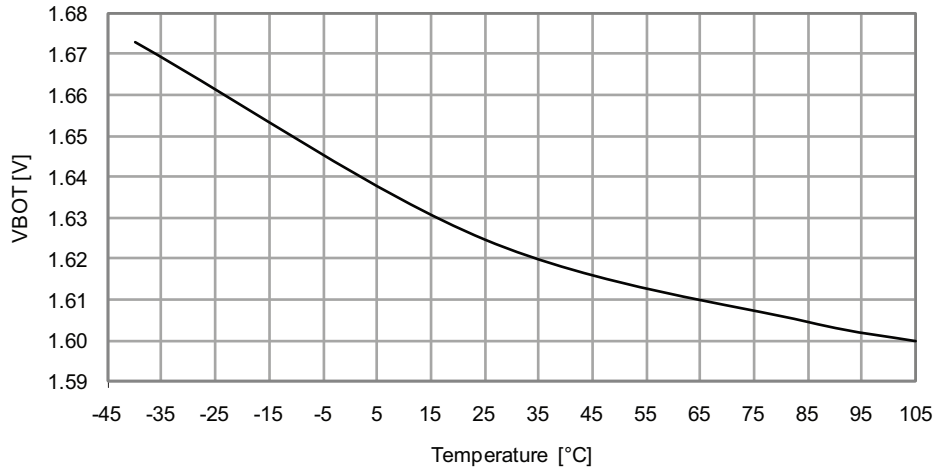


Figure 33-339. 2MHz Internal Oscillator Frequency vs. Temperature

DFLL enabled, from the 32.768kHz internal oscillator

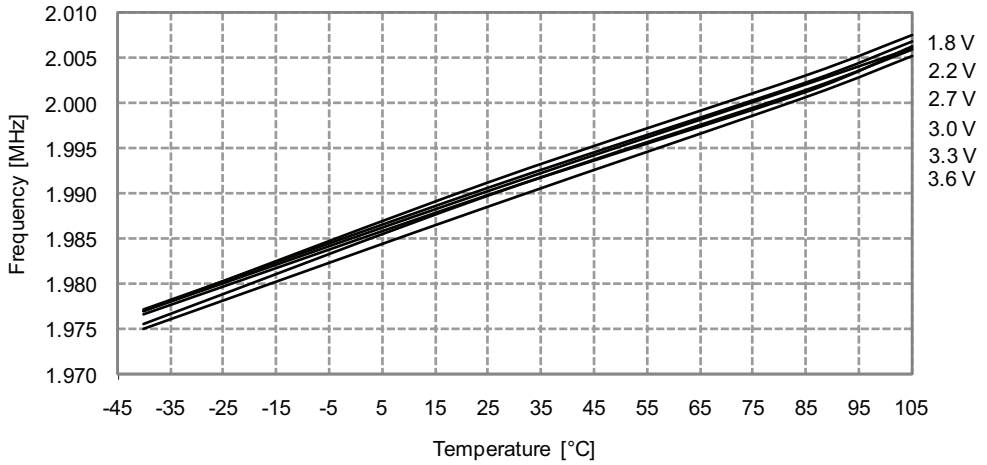


Figure 33-340. 2MHz Internal Oscillator Frequency vs. CALA Calibration Value

V_{CC} = 3V

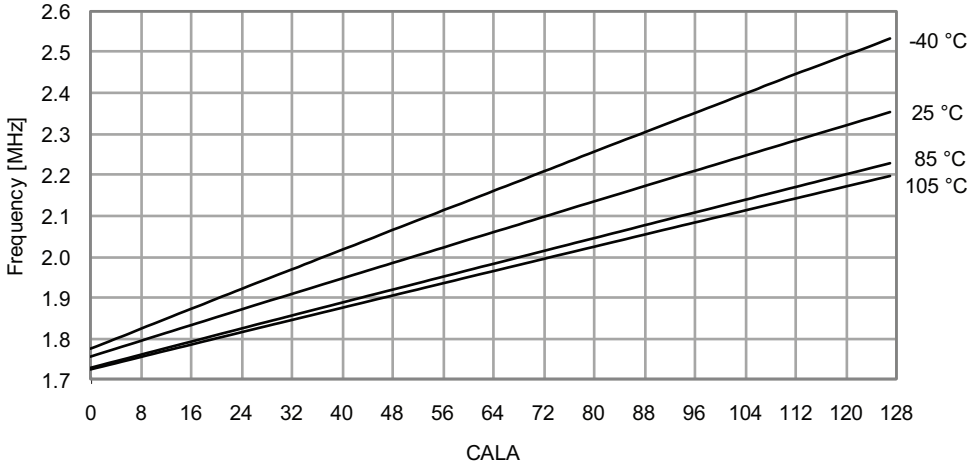
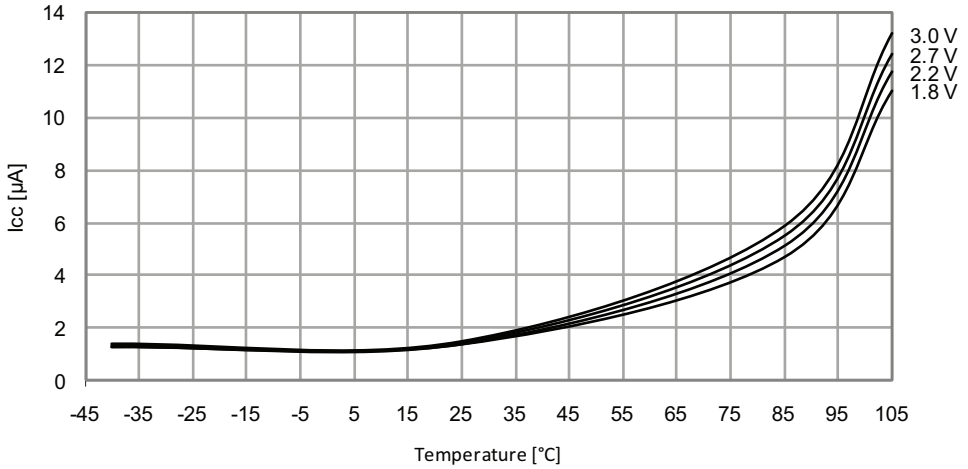


Figure 33-369.Power-down Mode Supply Current vs. Temperature

Watchdog and sampled BOD enabled and running from internal ULP oscillator

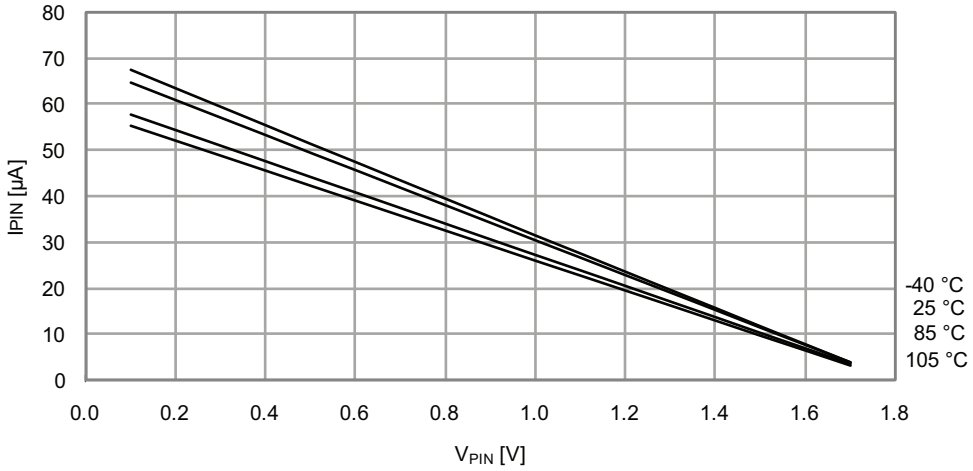


33.6.2 I/O Pin Characteristics

33.6.2.1 Pull-up

Figure 33-370.I/O Pin Pull-up Resistor Current vs. Input Voltage

V_{CC} = 1.8V



34. Errata

34.1 Atmel ATxmega32D3

34.1.1 Rev. I

- AC system status flags are only valid if AC-system is enabled
- Sampled BOD in Active mode will cause noise when bandgap is used as reference
- Temperature sensor not calibrated

1. AC system status flags are only valid if AC-system is enabled

The status flags for the ac-output are updated even though the AC is not enabled which is invalid. Also, it is not possible to clear the AC interrupt flags without enabling either of the Analog comparators.

Problem fix/workaround

Software should clear the AC system flags once, after enabling the AC system before using the AC system status flags.

2. Sampled BOD in Active mode will cause noise when bandgap is used as reference

Using the BOD in sampled mode when the device is running in Active or Idle mode will add noise on the bandgap reference for ADC, DAC, and Analog Comparator.

Problem fix/workaround

If the bandgap is used as reference for either the ADC, DAC and Analog Comparator, the BOD must not be set in sampled mode.

3. Temperature sensor not calibrated

Temperature sensor factory calibration not implemented.

Problem fix/workaround

None.

34.1.2 Rev A - H

Not sampled.

34.2 Atmel ATxmega64D3

34.2.1 Rev. I

- AC system status flags are only valid if AC-system is enabled
- Sampled BOD in Active mode will cause noise when bandgap is used as reference
- Temperature sensor not calibrated

1. AC system status flags are only valid if AC-system is enabled

The status flags for the ac-output are updated even though the AC is not enabled which is invalid. Also, it is not possible to clear the AC interrupt flags without enabling either of the Analog comparators.

Problem fix/workaround

Software should clear the AC system flags once, after enabling the AC system before using the AC system status flags.

2. Sampled BOD in Active mode will cause noise when bandgap is used as reference

Using the BOD in sampled mode when the device is running in Active or Idle mode will add noise on the bandgap reference for ADC, DAC, and Analog Comparator.

Problem fix/workaround

If the bandgap is used as reference for either the ADC, DAC and Analog Comparator, the BOD must not be set in sampled mode.

3. Temperature sensor not calibrated

Temperature sensor factory calibration not implemented.

Problem fix/workaround

None.

34.2.2 Rev. H

Not sampled.

34.2.3 Rev. G

Not sampled.

34.2.4 Rev. F

Not sampled.

- CRC generator module
- ADC 1/2× gain option, and this configuration option in the GAIN bits in the ADC Channel CTRL register
- ADC VCC/2 reference option and this configuration option in the REFSEL bits on the ADC REFCTRL register
- ADC option to use internal Gnd as negative input in differential measurements and this configuration option in the MUXNEG bits in the ADC Channel MUXCTRL register
- ADC channel scan and the ADC SCAN register
- ADC current limitation option, and the CURRLIMIT bits in the ADC CTRLB register
- ADC impedance mode selection for the gain stage, and the IMPMODE bit in the ADC CTRLB register
- Timer/Counter 2 and the SPLITMODE configuration option in the BYTEM bits in the Timer/Counter 0 CTRLE register
- Analog Comparator (AC) current output option, and the AC CURRCTRL and CURRCALIB registers
- PORT remap functions with alternate pin locations for Timer/Counter output compare channels, USART0 and SPI, and the PORT REMAP register
- PORT RTC clock output option and the RTCOUT bit in the PORT CLKEVOUT register
- PORT remap functions with alternate pin locations for the clock and event output, and the CLKEVPIN bit in the PORT CLKEVOUT register
- TOSC alternate pin locations, and TOSCSEL bit in FUSEBYTE2
- Real Time Counter clock source options of external clock from TOSC1, and 32.768kHz from TOSC, and 32.768kHz from the 32.768kHz internal oscillator, and these configuration options in the RTCSRC bits in the Clock RTCTRL register
- PLL divide by two option, and the PLLDIV bit in the Clock PLLCTRL register
- PLL lock detection failure function and the PLLDIF and PLLFDEN bits in the Clock XOSCFAIL register
- The high drive option for external crystal and the XOSCPWR bit on the Oscillator XOSCCTRL register
- The option to enable sequential startup of the analog modules and the ANAINIT register in MCU Control memory

Problem fix/workaround

None.

26. Sampled BOD in Active mode will cause noise when bandgap is used as reference

Using the BOD in sampled mode when the device is running in Active or Idle mode will add noise on the bandgap reference for ADC, DAC and Analog Comparator.

Problem fix/workaround

If the bandgap is used as reference for either the ADC, DAC and Analog Comparator, the BOD must not be set in sampled mode.

27. Temperature sensor not calibrated

Temperature sensor factory calibration not implemented.

Problem fix/workaround

None.

28. Disabling of USART transmitter does not automatically set the TxD pin direction to input

If the USART transmitter is idle with no frames to transmit, setting TXEN to zero will not automatically set the TxD pin direction to input.