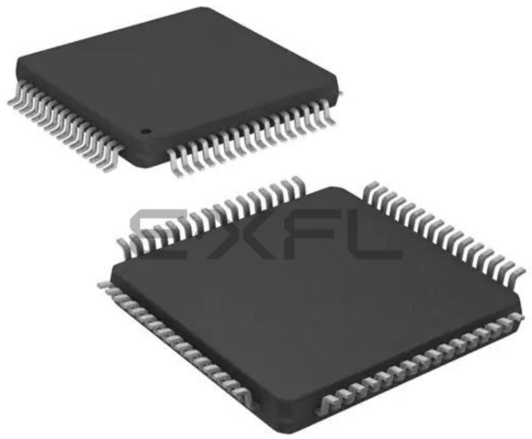


What is "Embedded - Microcontrollers"?

"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, USB
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	50
Program Memory Size	32KB (16K x 16)
Program Memory Type	FLASH
EEPROM Size	2K 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 ~ 105°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/atxmega32c3-an

Ordering code	Flash [bytes]	EEPROM [bytes]	SRAM [bytes]	Speed [MHz]	Power supply	Package (1)(2)(3)	Temp.
ATxmega256C3-AN	256K + 8K	4K	16K	32	1.6 - 3.6V	64A	-40°C - 105°C
ATxmega256C3-ANR(4)	256K + 8K	4K	16K				
ATxmega192C3-AN	192K + 8K	2K	16K				
ATxmega192C3-ANR(4)	192K + 8K	2K	16K				
ATxmega128C3-AN	128K + 8K	2K	8K				
ATxmega128C3-ANR(4)	128K + 8K	2K	8K				
ATxmega64C3-AN	64K + 4K	2K	4K				
ATxmega64C3-ANR(4)	64K + 4K	2K	4K				
ATxmega32C3-AN	32K + 4K	1K	4K				
ATxmega32C3-ANR(4)	32K + 4K	1K	4K				
ATxmega256C3-M7	256K + 8K	4K	16K			64M	
ATxmega256C3-M7R(4)	256K + 8K	4K	16K				
ATxmega192C3-M7	192K + 8K	2K	16K				
ATxmega192C3-M7R(4)	192K + 8K	2K	16K				
ATxmega128C3-M7	128K + 8K	2K	8K				
ATxmega128C3-M7R(4)	128K + 8K	2K	8K				
ATxmega64C3-M7	64K + 4K	2K	4K				
ATxmega64C3-M7R(4)	64K + 4K	2K	4K				
ATxmega32C3-M7	32K + 4K	1K	4K				
ATxmega32C3-M7R(4)	32K + 4K	1K	4K				

Notes:
1. This device can also be supplied in wafer form. Contact your local Atmel sales office for detailed ordering information.
2. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.
3. For packaging information, see "Packaging Information" on page 63.
4. Tape and Reel.

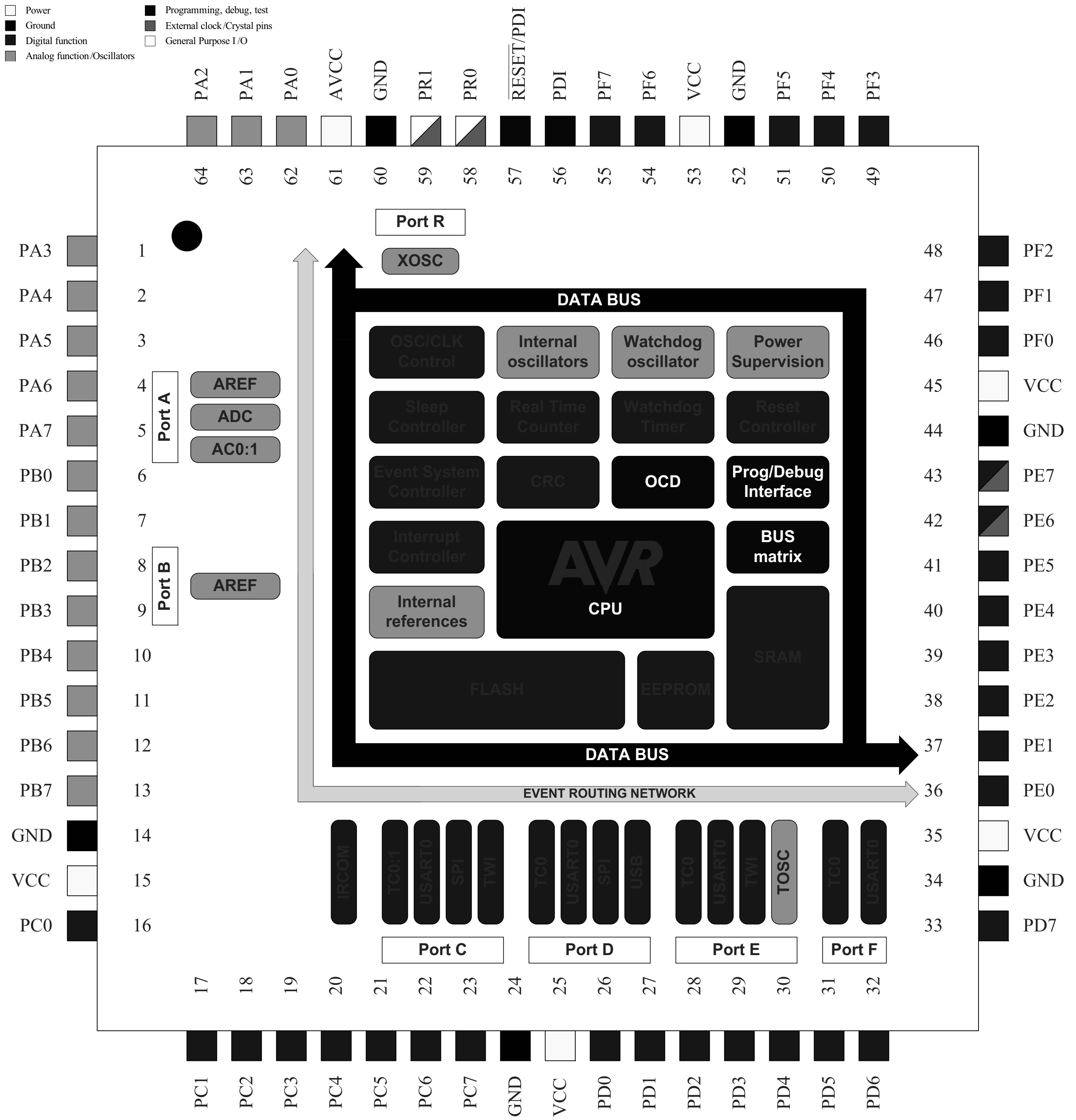
Package type	
64A	64-lead, 14 * 14mm body size, 1.0mm body thickness, 0.8mm lead pitch, thin profile plastic quad flat package (TQFP)
64M	64-pad, 9 * 9 *1.0mm body size, lead pitch 0.50mm, 7.65mm exposed quad, flat no-lead package (QFN)

Typical Applications

Industrial control	Climate control	Low power battery applications
Factory automation	RF and ZigBee®	Power tools
Building control	USB connectivity	HVAC
Board control	Sensor control	Utility metering
White goods	Optical	Medical applications

2. Pinout/Block Diagram

Figure 2-1. Block Diagram and Pinout



Notes: 1. For full details on pinout and alternate pin functions refer to "Pinout and Pin Functions" on page 51.
2. The large center pad underneath the QFN/MLF package should be soldered to ground on the board to ensure good mechanical stability.

3. Overview

The Atmel AVR XMEGA is a family of low power, high performance, and peripheral rich 8/16-bit microcontrollers based on the AVR enhanced RISC architecture. By executing instructions in a single clock cycle, the AVR XMEGA devices achieve CPU throughput approaching one million instructions per second (MIPS) per megahertz, allowing the system designer to optimize power consumption versus processing speed.

The AVR CPU combines a rich instruction set with 32 general purpose working registers. All 32 registers are directly connected to the arithmetic logic unit (ALU), allowing two independent registers to be accessed in a single instruction, executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs many times faster than conventional single-accumulator or CISC based microcontrollers.

The XMEGA C3 devices provide the following features: in-system programmable flash with read-while-write capabilities; internal EEPROM and SRAM; four-channel event system and programmable multilevel interrupt controller, 50 general purpose I/O lines, 16-bit real-time counter (RTC); five, 16-bit timer/counters with compare and PWM channels; three USARTs; two two-wire serial interfaces (TWIs); one full speed USB 2.0 interface; two serial peripheral interfaces (SPIs); one sixteen-channel, 12-bit ADC with programmable gain; two analog comparators (ACs) with window mode; programmable watchdog timer with separate internal oscillator; accurate internal oscillators with PLL and prescaler; and programmable brown-out detection.

The program and debug interface (PDI), a fast, two-pin interface for programming and debugging, is available.

The XMEGA C3 devices have five software selectable power saving modes. The idle mode stops the CPU while allowing the SRAM, event system, interrupt controller, and all peripherals to continue functioning. The power-down mode saves the SRAM and register contents, but stops the oscillators, disabling all other functions until the next TWI, USB resume, or pin-change interrupt, or reset. In power-save mode, the asynchronous real-time counter continues to run, allowing the application to maintain a timer base while the rest of the device is sleeping. In standby mode, the external crystal oscillator keeps running while the rest of the device is sleeping. This allows very fast startup from the external crystal, combined with low power consumption. In extended standby mode, both the main oscillator and the asynchronous timer continue to run. To further reduce power consumption, the peripheral clock to each individual peripheral can optionally be stopped in active mode and idle sleep mode.

Atmel offers a free QTouch library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers.

The devices are manufactured using Atmel high-density, nonvolatile memory technology. The program flash memory can be reprogrammed in-system through the PDI. A boot loader running in the device can use any interface to download the application program to the flash memory. The boot loader software in the boot flash section will continue to run while the application flash section is updated, providing true read-while-write operation. By combining an 8/16-bit RISC CPU with in-system, self-programmable flash, the AVR XMEGA is a powerful microcontroller family that provides a highly flexible and cost effective solution for many embedded applications.

All Atmel AVR XMEGA devices are supported with a full suite of program and system development tools, including: C compilers, macro assemblers, program debugger/simulators, programmers, and evaluation kits.

Six of the 32 registers can be used as three 16-bit address register pointers for data space addressing, enabling efficient address calculations. One of these address pointers can also be used as an address pointer for lookup tables in flash program memory.

7. Memories

7.1 Features

- Flash program memory
  - One linear address space
  - In-system programmable
  - Self-programming and boot loader support
  - Application section for application code
  - Application table section for application code or data storage
  - Boot section for application code or boot loader code
  - Separate read/write protection lock bits 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
    - Four bit-accessible general purpose registers for global variables or flags
  - Separate buses for SRAM, EEPROM and I/O memory
    - Simultaneous bus access for CPU
- Production signature row memory for factory programmed data
  - ID for each microcontroller device type
  - Serial number for each device
  - Calibration bytes for factory calibrated peripherals
- 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 Atmel AVR architecture has two main memory spaces, the program memory and the data memory. Executable code can reside only in the program memory, while data can be stored in the program memory and the data memory. The data memory includes the internal SRAM, and EEPROM for nonvolatile data storage. All memory spaces are linear and require no memory bank switching. Nonvolatile memory (NVM) spaces can be locked for further write and read/write operations. This prevents unrestricted access to the application software.

A separate memory section contains the fuse bytes. These are used for configuring important system functions, and can only be written by an external programmer.

The available memory size configurations are shown in "Pinout/Block Diagram" on page 4. In addition, each device has a Flash memory signature row for calibration data, device identification, serial number etc.

7.3 Flash Program Memory

The Atmel AVR XMEGA devices contain on-chip, in-system reprogrammable flash memory for program storage. The flash memory can be accessed for read and write from an external programmer through the PDI or from application software running in the device.

1kHz output. The oscillator is automatically enabled/disabled when it is used as clock source for any part of the device. This oscillator can be selected as the clock source for the RTC.

9.3.2 32.768kHz Calibrated Internal Oscillator

This oscillator provides an approximate 32.768kHz clock. It is calibrated during production to provide a default frequency close to its nominal frequency. The calibration register can also be written from software for run-time calibration of the oscillator frequency. The oscillator employs a built-in prescaler, which provides both a 32.768kHz output and a 1.024kHz output.

9.3.3 32.768kHz Crystal Oscillator

A 32.768kHz crystal oscillator can be connected between the TOSC1 and TOSC2 pins and enables a dedicated low frequency oscillator input circuit. A low power mode with reduced voltage swing on TOSC2 is available. This oscillator can be used as a clock source for the system clock and RTC, and as the DFLL reference clock.

9.3.4 0.4 - 16MHz Crystal Oscillator

This oscillator can operate in four different modes optimized for different frequency ranges, all within 0.4 - 16MHz.

9.3.5 2MHz Run-time Calibrated Internal Oscillator

The 2MHz run-time calibrated internal oscillator is the default system clock source after reset. It is calibrated during production to provide a default frequency close to its nominal frequency. A DFLL can be enabled for automatic run-time calibration of the oscillator to compensate for temperature and voltage drift and optimize the oscillator accuracy.

9.3.6 32MHz Run-time Calibrated Internal Oscillator

The 32MHz run-time calibrated internal oscillator is a high-frequency oscillator. It is calibrated during production to provide a default frequency close to its nominal frequency. A digital frequency looked loop (DFLL) can be enabled for automatic run-time calibration of the oscillator to compensate for temperature and voltage drift and optimize the oscillator accuracy. This oscillator can also be adjusted and calibrated to any frequency between 30MHz and 55MHz. The production signature row contains 48MHz calibration values intended used when the oscillator is used a full-speed USB clock source.

9.3.7 External Clock Sources

The XTAL1 and XTAL2 pins can be used to drive an external oscillator, either a quartz crystal or a ceramic resonator. XTAL1 can be used as input for an external clock signal. The TOSC1 and TOSC2 pins is dedicated to driving a 32.768kHz crystal oscillator.

9.3.8 PLL with 1x-31x Multiplication Factor

The built-in phase locked loop (PLL) can be used to generate a high-frequency system clock. The PLL has a user-selectable multiplication factor of from 1 to 31. In combination with the prescalers, this gives a wide range of output frequencies from all clock sources.

33.2 Atmel ATxmega64C3

33.2.1 Absolute Maximum Ratings

Stresses beyond those listed in Table 33-30 under may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 33-30. Absolute Maximum Ratings

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{CC}	Power supply voltage		-0.3		4	V
I_{VCC}	Current into a V_{CC} pin				200	mA
I_{GND}	Current out of a GND pin				200	
V_{PIN}	Pin voltage with respect to GND and V_{CC}		-0.5		V_{CC}+0.5	V
I_{PIN}	I/O pin sink/source current		-25		25	mA
T_A	Storage temperature		-65		150	°C
T_j	Junction temperature				150	

33.2.2 General Operating Ratings

The device must operate within the ratings listed in Table 33-31 in order for all other electrical characteristics and typical characteristics of the device to be valid.

Table 33-31. General Operating Conditions

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{CC}	Power supply voltage		1.60		3.6	V
AV_{CC}	Analog supply voltage		1.60		3.6	
T_A	Temperature range		-40		85	°C
T_j	Junction temperature		-40		105	

Table 33-32. Operating Voltage and Frequency

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
Clk_{CPU}	CPU clock frequency	V_{CC} = 1.6V	0		12	MHz
		V_{CC} = 1.8V	0		12	
		V_{CC} = 2.7V	0		32	
		V_{CC} = 3.6V	0		32	

Symbol	Parameter	Condition		Min.	Typ.	Max.	Units
R_Q	Negative impedance(1)	XOSCPWR=0, FRQRANGE=0	0.4MHz resonator, CL=100pF		44k		Ω
			1MHz crystal, CL=20pF		67k		
			2MHz crystal, CL=20pF		67k		
		XOSCPWR=0, FRQRANGE=1, CL=20pF	2MHz crystal		82k		
			8MHz crystal		1500		
			9MHz crystal		1500		
		XOSCPWR=0, FRQRANGE=2, CL=20pF	8MHz crystal		2700		
			9MHz crystal		2700		
			12MHz crystal		1000		
		XOSCPWR=0, FRQRANGE=3, CL=20pF	9MHz crystal		3600		
			12MHz crystal		1300		
			16MHz crystal		590		
		XOSCPWR=1, FRQRANGE=0, CL=20pF	9MHz crystal		390		
			12MHz crystal		50		
			16MHz crystal		10		
		XOSCPWR=1, FRQRANGE=1, CL=20pF	9MHz crystal		1500		
			12MHz crystal		650		
			16MHz crystal		270		
		XOSCPWR=1, FRQRANGE=2, CL=20pF	12MHz crystal		1000		
			16MHz crystal		440		
		XOSCPWR=1, FRQRANGE=3, CL=20pF	12MHz crystal		1300		
			16MHz crystal		590		
	ESR	SF = safety factor				min (R_Q)/SF	kΩ
	Start-up time	XOSCPWR=0, FRQRANGE=0	0.4MHz resonator, CL=100pF		1.0		ms
		XOSCPWR=0, FRQRANGE=1	2MHz crystal, CL=20pF		2.6		
		XOSCPWR=0, FRQRANGE=2	8MHz crystal, CL=20pF		0.8		
		XOSCPWR=0, FRQRANGE=3	12MHz crystal, CL=20pF		1.0		
		XOSCPWR=1, FRQRANGE=3	16MHz crystal, CL=20pF		1.4		

34.1.1.3 Power-down Mode Supply Current

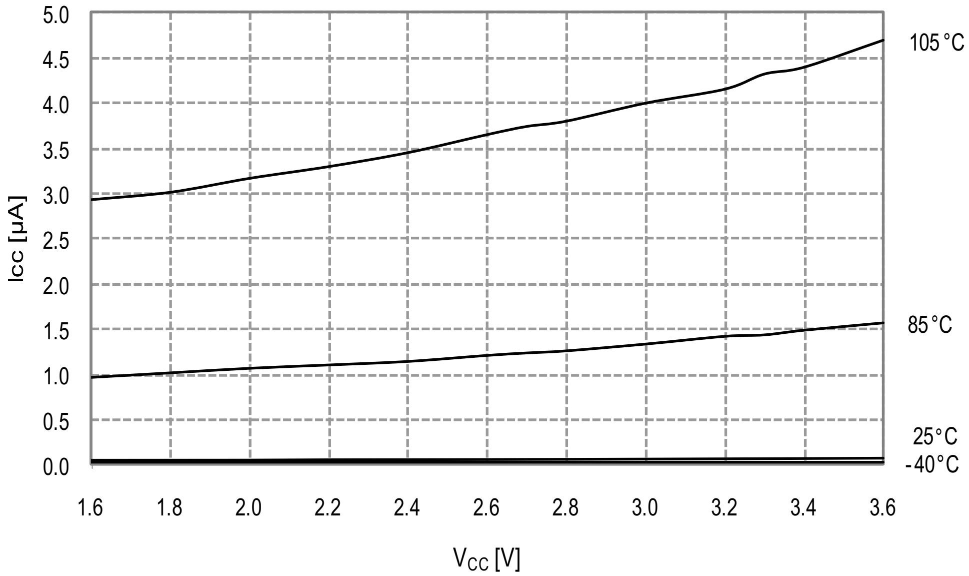


Figure 34-15. Power-down Mode Supply Current vs. V_{CC}
All functions disabled

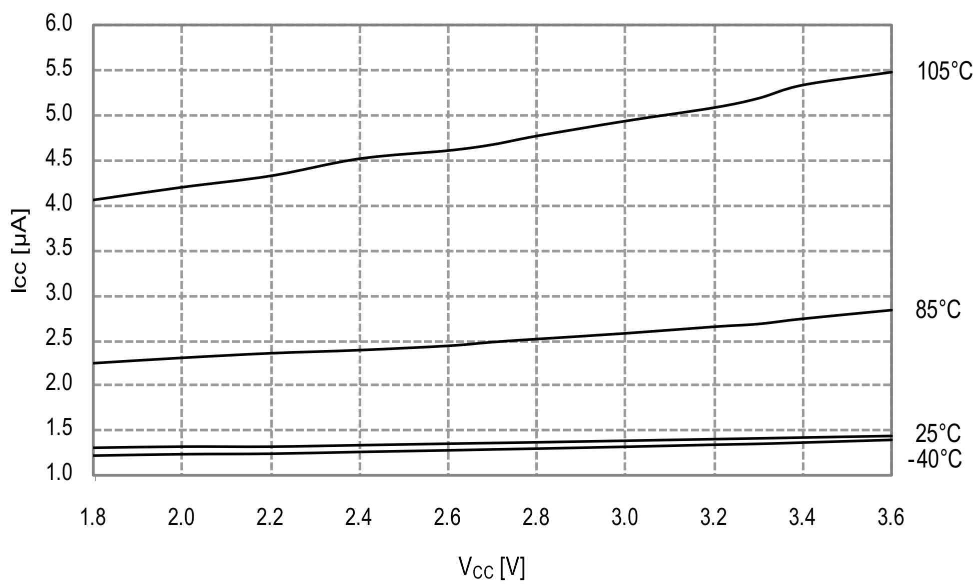
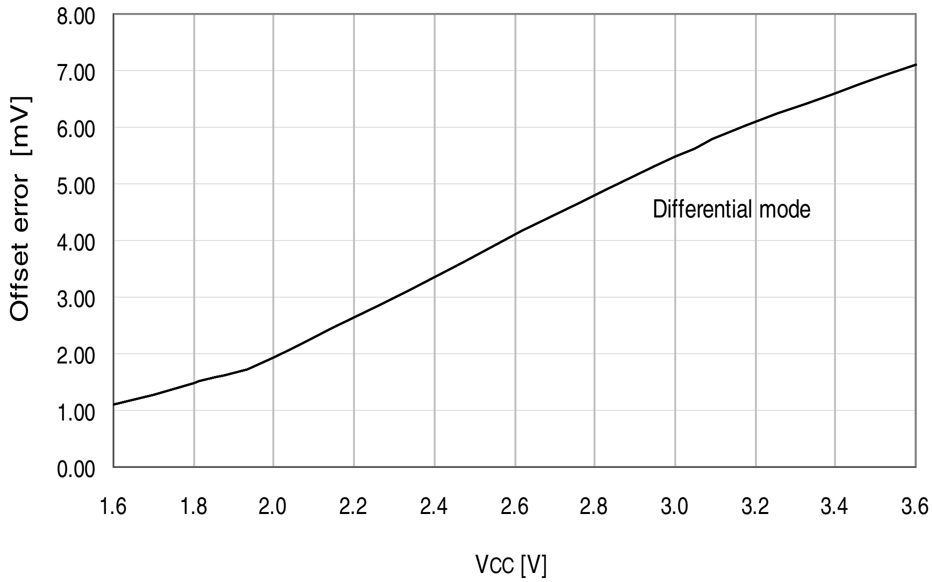


Figure 34-16. Power-down Mode Supply Current vs. V_{CC}
Watchdog and sampled BOD enabled

Figure 34-41. Offset Error vs. V_{CC}

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



34.1.4 Analog Comparator Characteristics

Figure 34-42. Analog Comparator Hysteresis vs. V_{CC}

Small hysteresis

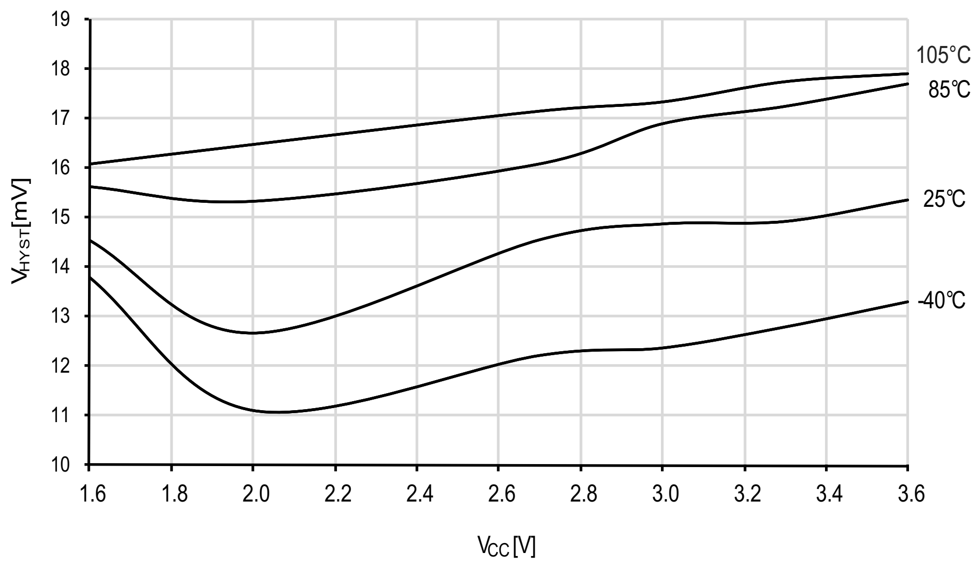


Figure 34-51. Reset Pin Pull-up Resistor Current vs. Reset Pin Voltage

V_{CC} = 3.0V

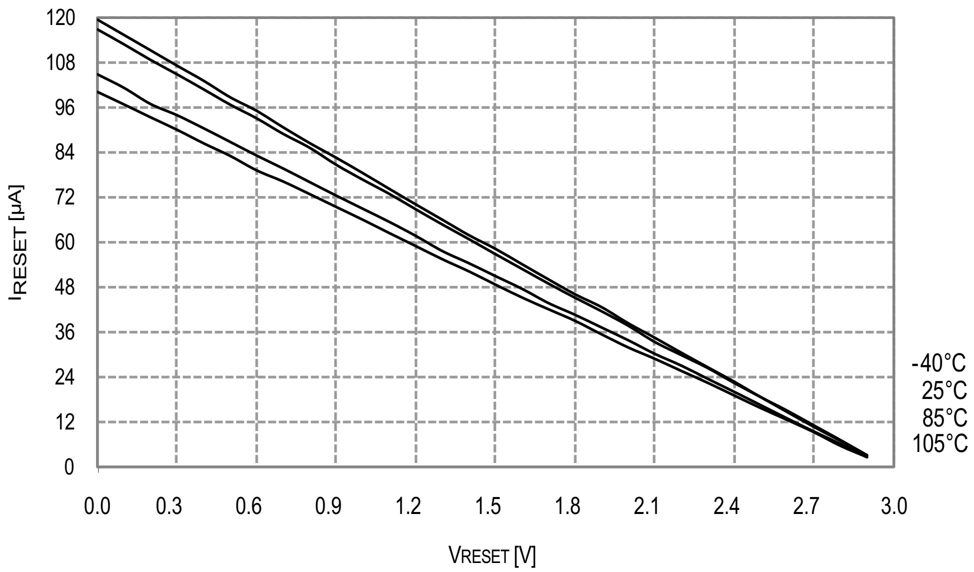


Figure 34-52. Reset Pin Pull-up Resistor Current vs. Reset Pin Voltage

V_{CC} = 3.3V

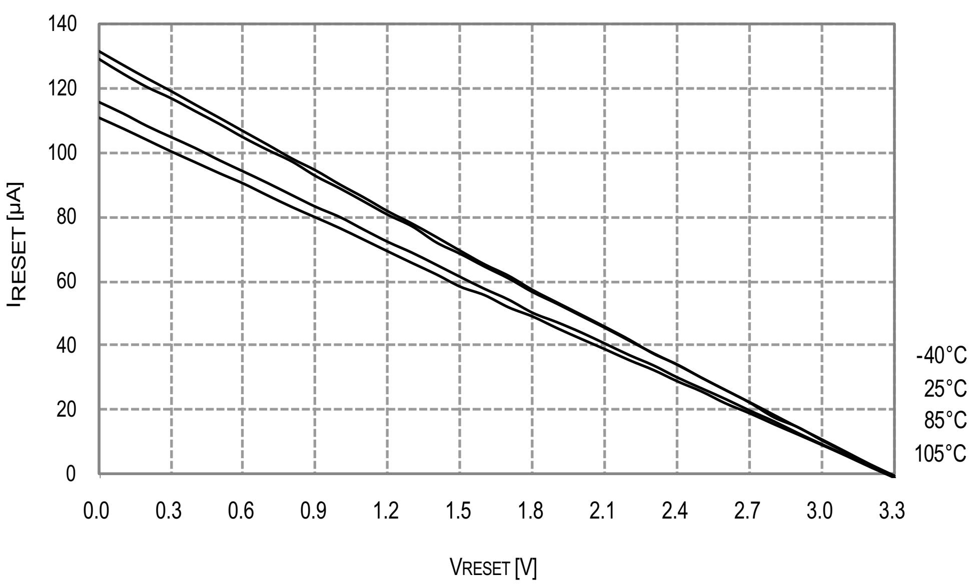
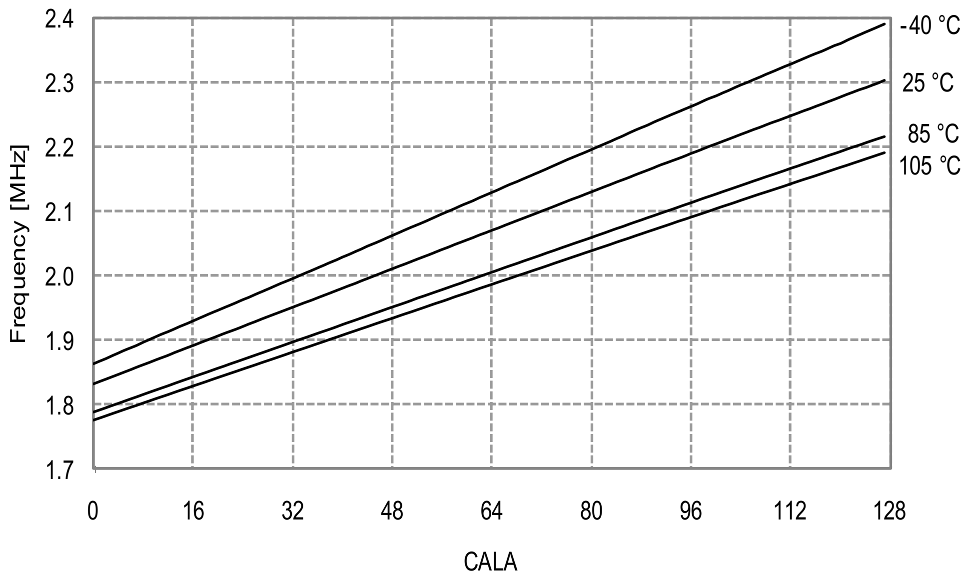


Figure 34-59. 2MHz Internal Oscillator Frequency vs. CALA Calibration Value
V_{CC} = 3V



34.1.8.4 32MHz Internal Oscillator

Figure 34-60. 32MHz Internal Oscillator Frequency vs. Temperature
DFLL disabled

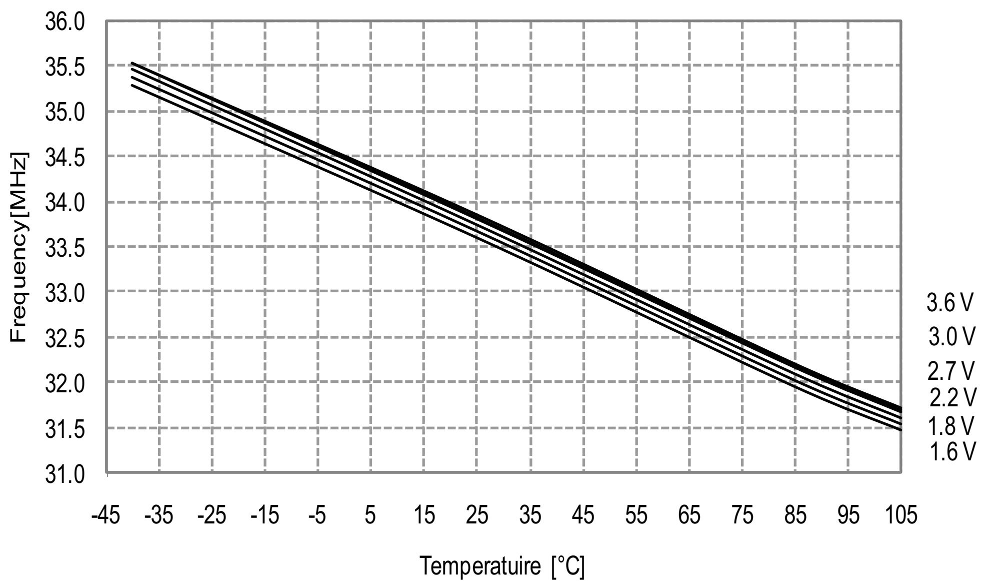


Figure 34-84. Idle Mode Supply Current vs. V_{CC}

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

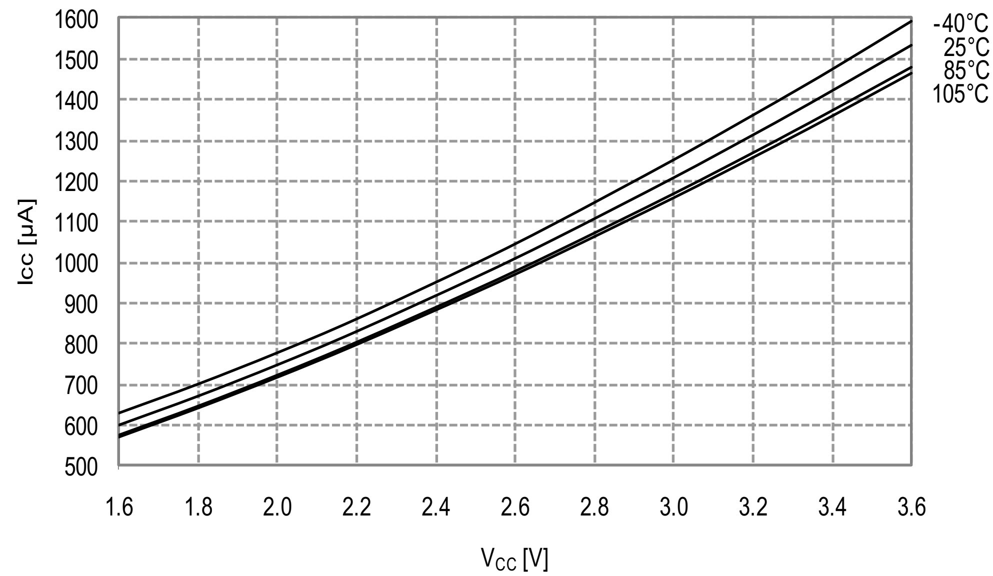


Figure 34-85. Idle Mode Current vs. V_{CC}

f_{SYS} = 32MHz internal oscillator

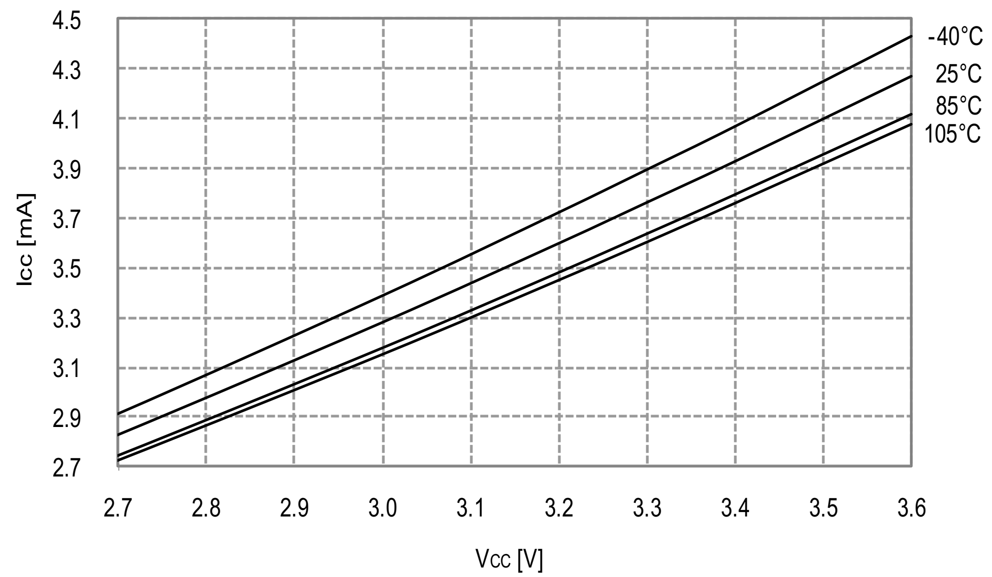


Figure 34-94. I/O Pin Output Voltage vs. Source Current

V_{CC} = 3.0V

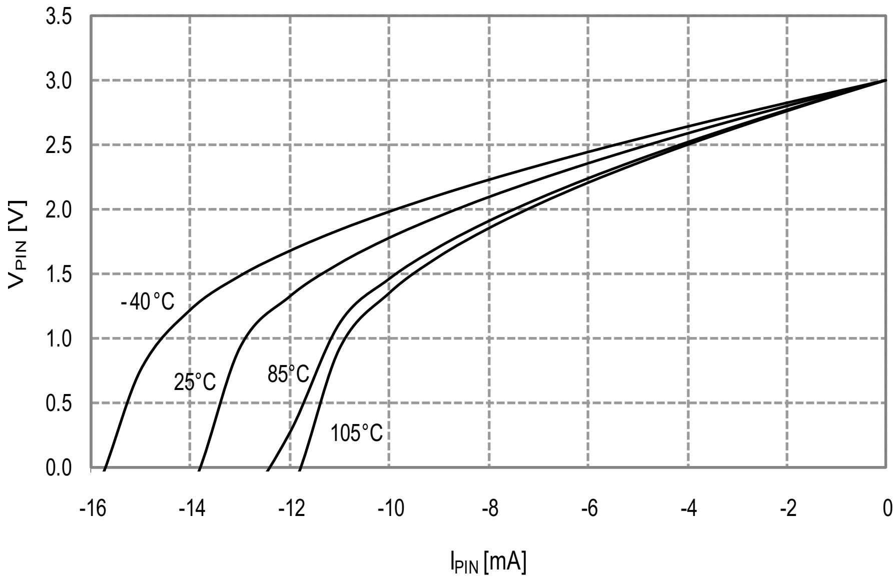


Figure 34-95. I/O Pin Output Voltage vs. Source Current

V_{CC} = 3.3V

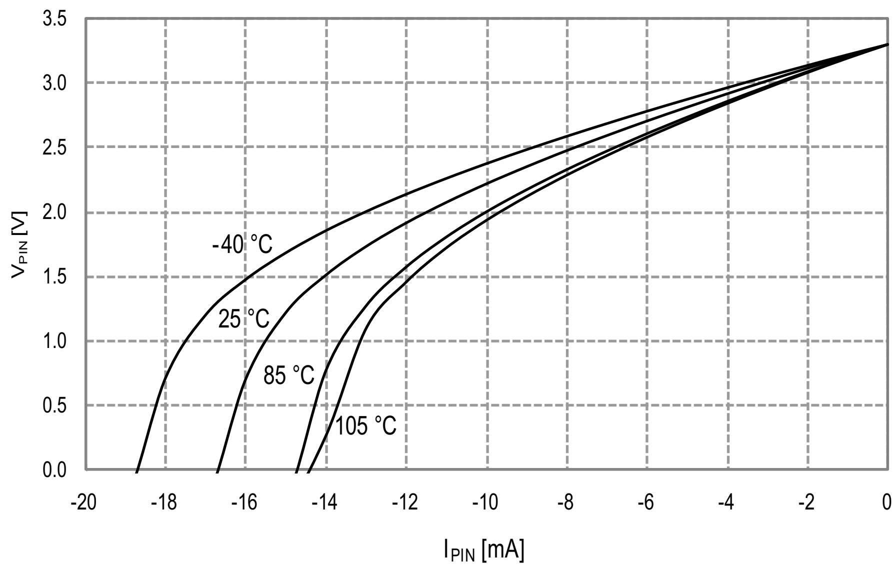
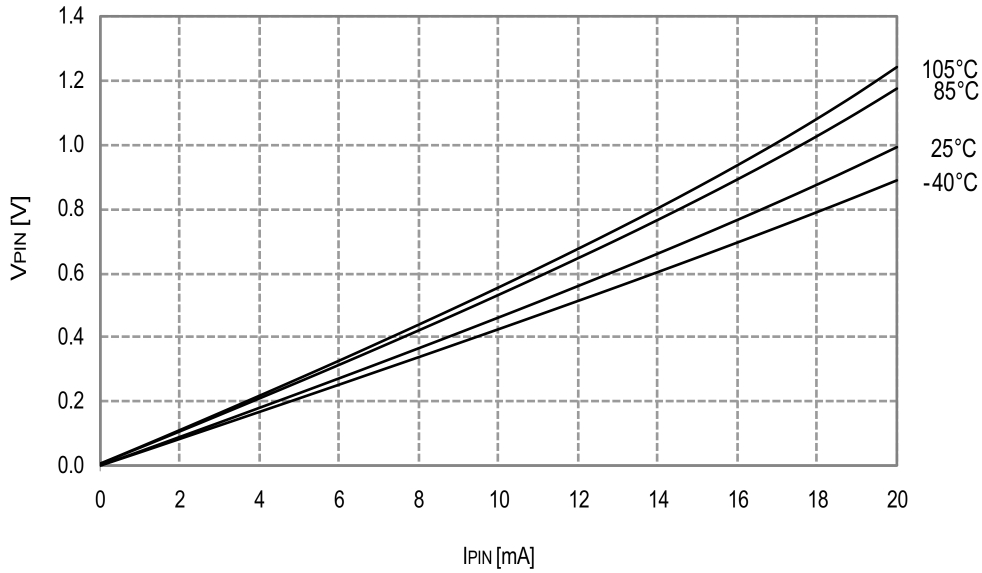


Figure 34-98. I/O Pin Output Voltage vs. Sink Current

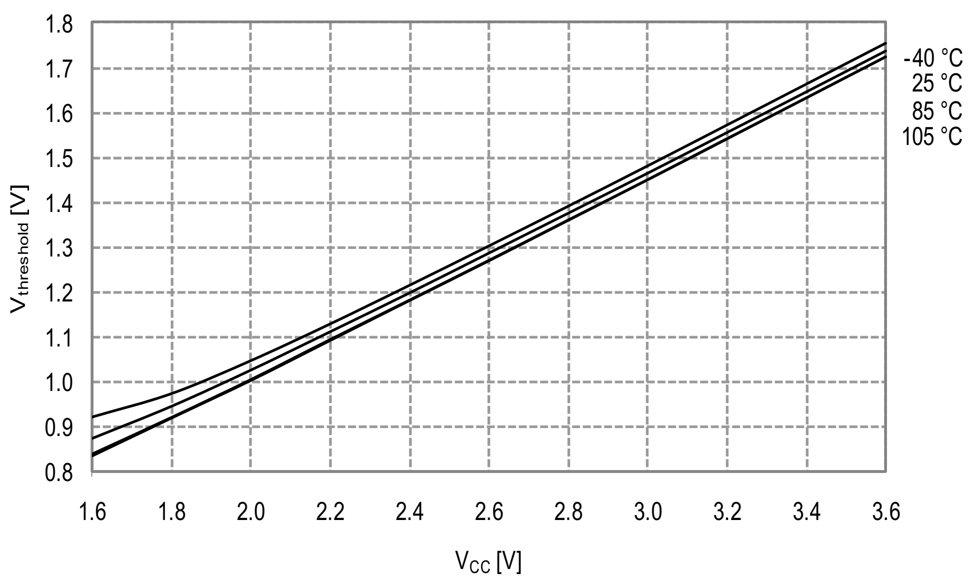
V_{CC} = 3.3V



34.2.2.3 Thresholds and Hysteresis

Figure 34-99. I/O Pin Input Threshold Voltage vs. V_{CC}

V_{IH} I/O pin read as "1"



34.2.3 ADC Characteristics

Figure 34-102. INL Error vs. External V_{REF}

T = 25°C, V_{CC} = 3.6V, external reference

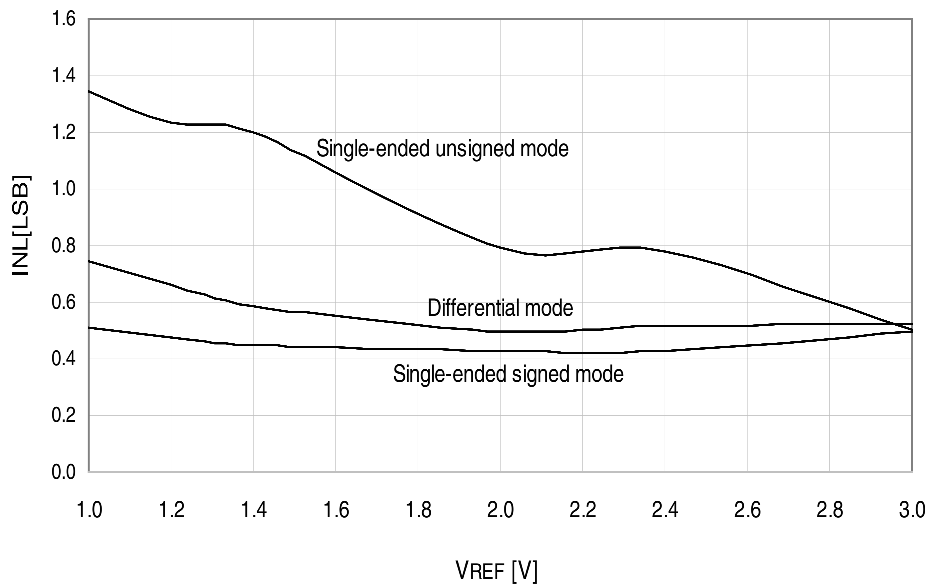
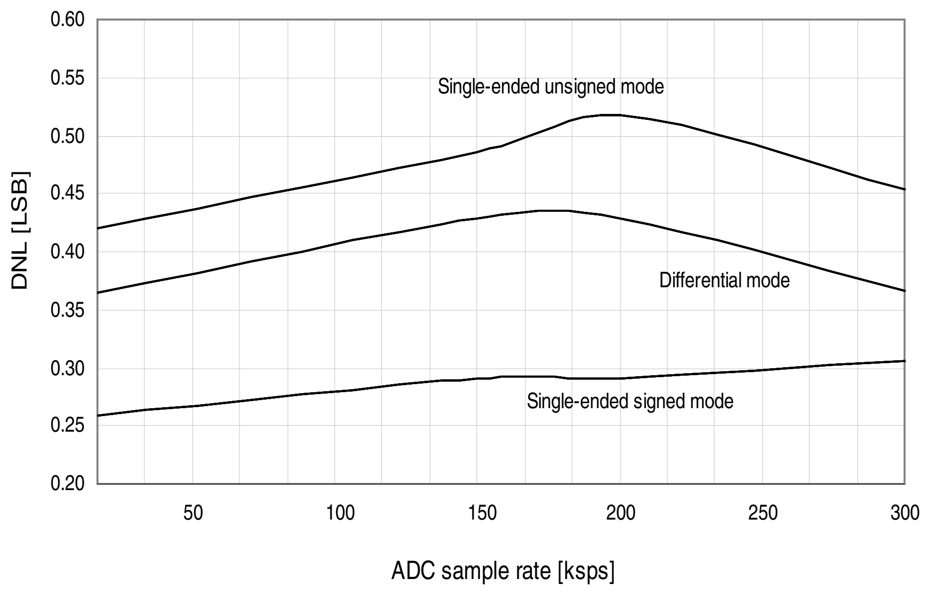


Figure 34-103. INL Error vs. Sample Rate

T = 25°C, V_{CC} = 3.6V, V_{REF} = 3.0V external



34.2.8.3 2MHz Internal Oscillator

Figure 34-128. 2MHz Internal Oscillator Frequency vs. Temperature

DFLL disabled

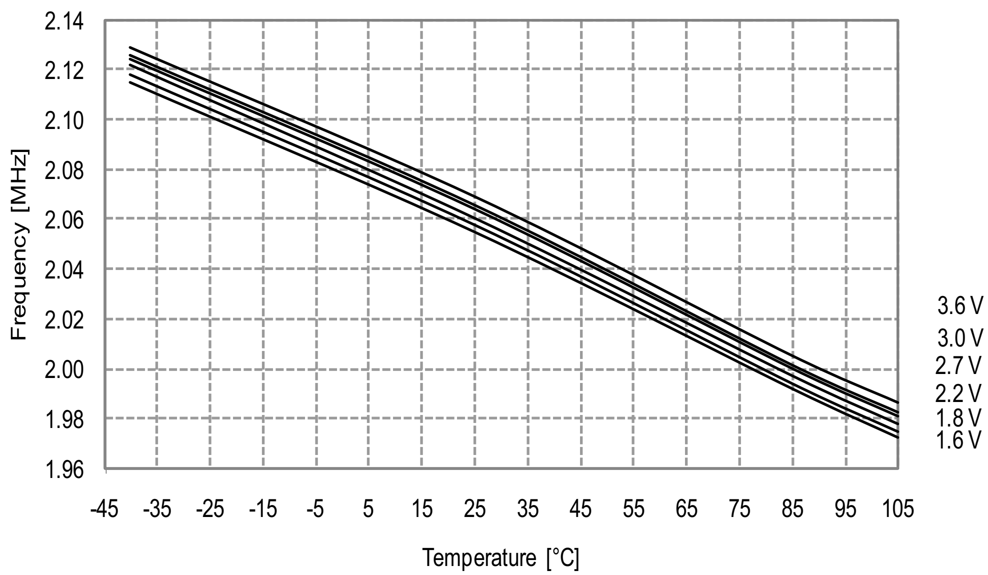


Figure 34-129. 2MHz Internal Oscillator Frequency vs. Temperature

DFLL enabled, from the 32.768kHz internal oscillator

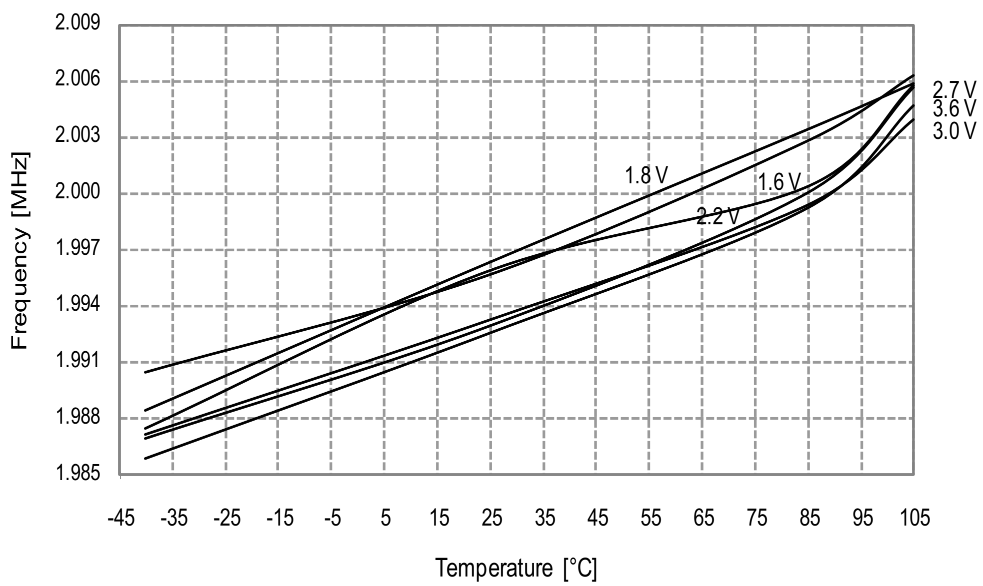
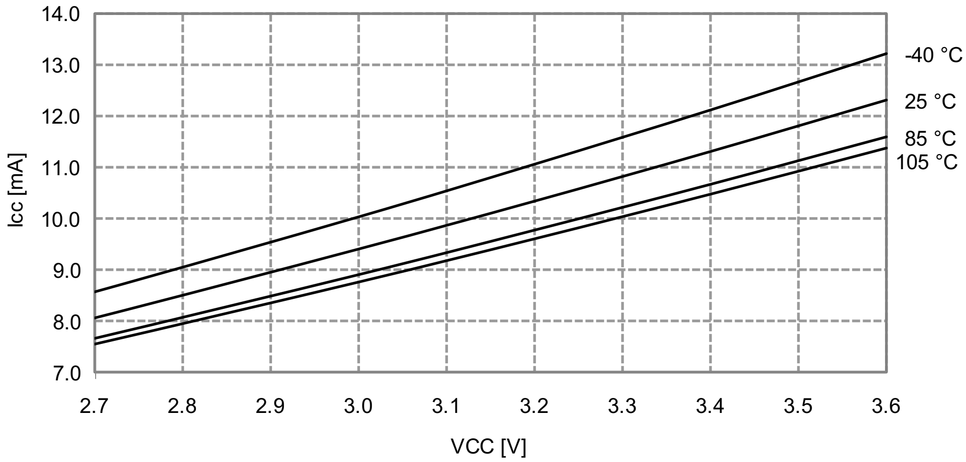


Figure 34-219. Active Mode Supply Current vs. V_{CC}

f_{SYS} = 32MHz internal oscillator



34.4.1.2 Idle Mode Supply Current

Figure 34-220. Idle Mode Supply Current vs. Frequency

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

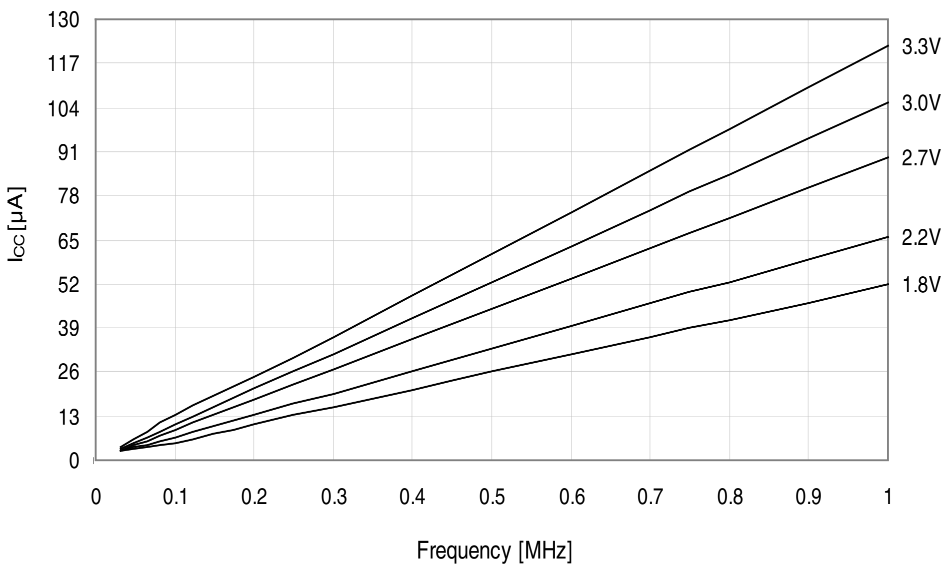


Figure 34-231. I/O Pin Pull-up Resistor Current vs. Input Voltage

V_{CC} = 3.0V

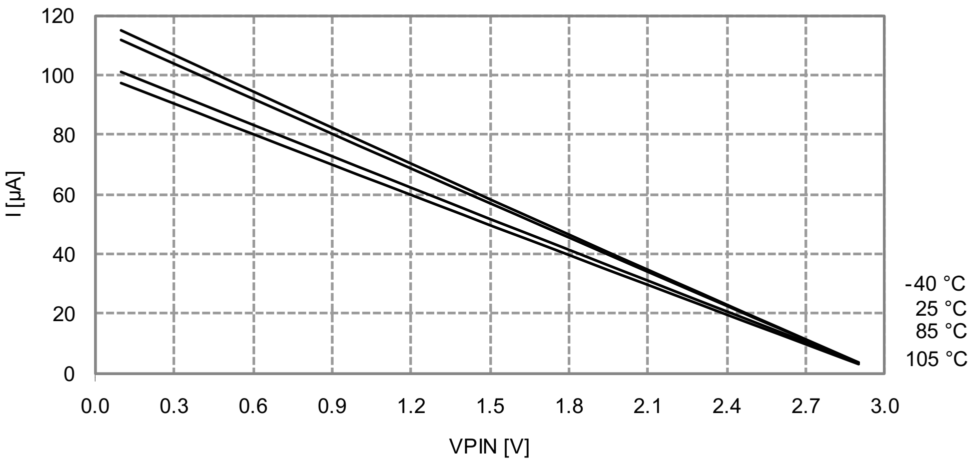


Figure 34-232. I/O Pin Pull-up Resistor Current vs. Input Voltage

V_{CC} = 3.3V