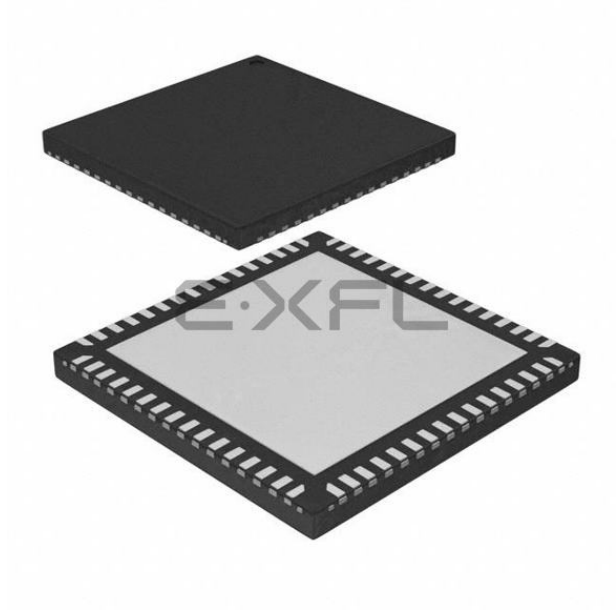

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What is "Embedded - Microcontrollers"?

"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, 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-VFQFN Exposed Pad
Supplier Device Package	64-QFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atxmega32c3-mnr

All AVR CPU instructions are 16 or 32 bits wide, and each flash location is 16 bits wide. The flash memory is organized in two main sections, the application section and the boot loader section. The sizes of the different sections are fixed, but device-dependent. These two sections have separate lock bits, and can have different levels of protection. The store program memory (SPM) instruction, which is used to write to the flash from the application software, will only operate when executed from the boot loader section.

The application section contains an application table section with separate lock settings. This enables safe storage of nonvolatile data in the program memory.

Figure 7-1. Flash Program Memory (hexadecimal address)

Word Address									
ATxmega256C3		**ATxmega192C3**		**ATxmega128C3**		**ATxmega64C3**		**ATxmega32C3**	
0		0		0		0		0	Application section (256K/192K/128K/64K/32K)
									.....
1EFFF	/	16FFF	/	EFFF	/	77FF	/	37FF	
1F000	/	17000	/	F000	/	7800	/	3800	Application table section (8K/8K/8K/4K/4K)
1FFFF	/	17FFF	/	FFFF	/	7FFF	/	3FFF	
20000	/	18000	/	10000	/	8000	/	4000	Boot section (8K/8K/8K/4K/4K)
20FFF	/	18FFF	/	10FFF	/	87FF	/	47FF	

7.3.1 Application Section

The Application section is the section of the flash that is used for storing the executable application code. The protection level for the application section can be selected by the boot lock bits for this section. The application section can not store any boot loader code since the SPM instruction cannot be executed from the application section.

7.3.2 Application Table Section

The application table section is a part of the application section of the flash memory that can be used for storing data. The size is identical to the boot loader section. The protection level for the application table section can be selected by the boot lock bits for this section. The possibilities for different protection levels on the application section and the application table section enable safe parameter storage in the program memory. If this section is not used for data, application code can reside here.

7.3.3 Boot Loader Section

While the application section is used for storing the application code, the boot loader software must be located in the boot loader section because the SPM instruction can only initiate programming when executing from this section. The SPM instruction can access the entire flash, including the boot loader section itself. The protection level for the boot loader section can be selected by the boot loader lock bits. If this section is not used for boot loader software, application code can be stored here.

7.3.4 Production Signature Row

The production signature row is a separate memory section for factory programmed data. It contains calibration data for functions such as oscillators and analog modules. Some of the calibration values will be automatically loaded to the corresponding module or peripheral unit during reset. Other values must be loaded from the signature row and written to the corresponding peripheral registers from software. For details on calibration conditions, refer to “Electrical Characteristics” on page 65.

24. IRCOM – IR Communication Module

24.1 Features

- Pulse modulation/demodulation for infrared communication
- IrDA compatible for baud rates up to 115.2Kbps
- Selectable pulse modulation scheme
  - 3/16 of the baud rate period
  - Fixed pulse period, 8-bit programmable
  - Pulse modulation disabled
- Built-in filtering
- Can be connected to and used by any USART

24.2 Overview

Atmel AVR XMEGA devices contain an infrared communication module (IRCOM) that is IrDA compatible for baud rates up to 115.2Kbps. It can be connected to any USART to enable infrared pulse encoding/decoding for that USART.

Table 29-3. Port C - Alternate Functions

PORT C	PIN #	INTERRUPT	TCC0[1][2]	AWEXC	TCC1	USARTC0[3]	SPIC[4]	TWIC	CLOCKOUT[5]	EVENTOUT[6]
PC0	16	SYNC	OC0A	$\overline{\text{OC0ALS}}$				SDA		
PC1	17	SYNC	OC0B	OC0AHS		XCK0		SCL		
PC2	18	SYNC/ASYNC	OC0C	$\overline{\text{OC0BLS}}$		RXD0				
PC3	19	SYNC	OC0D	OC0BHS		TXD0				
PC4	20	SYNC		$\overline{\text{OC0CLS}}$	OC1A		$\overline{\text{SS}}$			
PC5	21	SYNC		OC0CHS	OC1B		MOSI			
PC6	22	SYNC		$\overline{\text{OC0DLS}}$			MISO		RTCOUT	
PC7	23	SYNC		OC0DHS			SCK		clk_{PER}	EVOUT
GND	24									
VCC	25									

Notes:
1. Pin mapping of all TC0 can optionally be moved to high nibble of port.
2. If TC0 is configured as TC2 all eight pins can be used for PWM output.
3. Pin mapping of all USART0 can optionally be moved to high nibble of port.
4. Pins MOSI and SCK for all SPI can optionally be swapped.
5. CLKOUT can optionally be moved between port C, D, and E and between pin 4 and 7.
6. EVOUT can optionally be moved between port C, D, and E and between pin 4 and 7.

Table 29-4. Port D - Alternate Functions

PORT D	PIN #	INTERRUPT	TCD0	USARTD0	SPID	USB	CLOCKOUT	EVENTOUT
PD0	26	SYNC	OC0A					
PD1	27	SYNC	OC0B	XCK0				
PD2	28	SYNC/ASYNC	OC0C	RXD0				
PD3	29	SYNC	OC0D	TXD0				
PD4	30	SYNC			$\overline{\text{SS}}$			
PD5	31	SYNC			MOSI			
PD6	32	SYNC			MISO	D-		
PD7	33	SYNC			SCK	D+	Clk_{PER}	EVOUT
GND	34							
VCC	35							

Table 33-11. Gain Stage Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
R_{in}	Input resistance	Switched in normal mode		4.0		kΩ
C_{sample}	Input capacitance	Switched in normal mode		4.4		pF
	Signal range	Gain stage output	0		AV_{CC}- 0.6	V
	Propagation delay	ADC conversion rate	1/2	1	3	Clk_{ADC} cycles
	Clock frequency	Same as ADC	100		1800	kHz
	Gain error	0.5x gain, normal mode		-1		%
		1x gain, normal mode		-1		
		8x gain, normal mode		-1		
		64x gain, normal mode		5		
	Offset error, input referred	0.5x gain, normal mode		10		mV
		1x gain, normal mode		5		
		8x gain, normal mode		-20		
		64x gain, normal mode		-126		

33.1.7 Analog Comparator Characteristics

Table 33-12. Analog Comparator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{off}	Input offset voltage			10		mV
I_{lk}	Input leakage current			<10	50	nA
	Input voltage range		-0.1		AV_{CC}	V
	AC startup time			50		µs
V_{hys1}	Hysteresis, none	Vcc=1.6V - 3.6V		0		mV
V_{hys2}	Hysteresis, small	Vcc=1.6V - 3.6V		15		
V_{hys3}	Hysteresis, large	Vcc=1.6V - 3.6V		30		
t_{delay}	Propagation delay	V_{CC} = 3.0V, T= 85°C		20	40	ns
		V_{CC} = 3.0V		17		
	64-level voltage scaler	Integral non-linearity (INL)		0.3	0.5	lsb
	Current source accuracy after calibration			5		%
	Current source calibration range	Single mode	4		6	µA

33.3 Atmel ATxmega128C3

33.3.1 Absolute Maximum Ratings

Stresses beyond those listed in Table 33-59 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 33-59. 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	

33.3.2 General Operating Ratings

The device must operate within the ratings listed in Table 33-60 in order for all other electrical characteristics and typical characteristics of the device to be valid.

Table 33-60. 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 33-61. 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	

33.3.11 Power-on Reset Characteristics

Table 33-74. Power-on Reset Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{POT-} (1)	POR threshold voltage falling V_{CC}	V_{CC} falls faster than 1V/ms	0.4	1.0		V
		V_{CC} falls at 1V/ms or slower	0.8	1.3		
V_{POT+}	POR threshold voltage rising V_{CC}			1.3	1.59	

Note: 1. V_{POT-} values are only valid when BOD is disabled. When BOD is enabled $V_{POT-} = V_{POT+}$.

33.3.12 Flash and EEPROM Memory Characteristics

Table 33-75. Endurance and Data Retention

Symbol	Parameter	Condition		Min.	Typ.	Max.	Units
	Flash	Write/Erase cycles	25°C	10K			Cycle
			85°C	10K			
			105°C	2K			
		Data retention	25°C	100			Year
			85°C	25			
			105°C	10			
	EEPROM	Write/Erase cycles	25°C	100K			Cycle
			85°C	100K			
			105°C	30K			
		Data retention	25°C	100			Year
			85°C	25			
			105°C	10			

Table 33-76. Programming Time

Symbol	Parameter	Condition		Min.	Typ. (1)	Max.	Units
	Chip erase(2)	128KB Flash, EEPROM			75		ms
	Application erase	Section erase			6		
	Flash	Page erase			4		
		Page write			4		
		Atomic page erase and write			8		
	EEPROM	Page erase			4		
		Page write			4		
		Atomic page erase and write			8		

Notes: 1. Programming is timed from the 2MHz internal oscillator.
2. EEPROM is not erased if the EESAVE fuse is programmed.

33.3.13 Clock and Oscillator Characteristics

33.3.13.1 Calibrated 32.768kHz Internal Oscillator Characteristics

Table 33-77. 32.768kHz Internal Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Frequency			32.768		kHz
	Factory calibration accuracy	T = 85°C, V_{CC} = 3.0V	-0.5		0.5	%
	User calibration accuracy		-0.5		0.5	

33.3.13.2 Calibrated 2MHz RC Internal Oscillator Characteristics

Table 33-78. 2MHz Internal Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Frequency range	DFLL can tune to this frequency over voltage and temperature	1.8	2.0	2.2	MHz
	Factory calibrated frequency			2.0		
	Factory calibration accuracy	T = 85°C, V_{CC}= 3.0V	-1.5		1.5	%
	User calibration accuracy		-0.2		0.2	
	DFLL calibration stepsize			0.18		

33.3.13.3 Calibrated and Tunable 32MHz Internal Oscillator Characteristics

Table 33-79. 32MHz Internal Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Frequency range	DFLL can tune to this frequency over voltage and temperature	30	32	55	MHz
	Factory calibrated frequency			32		
	Factory calibration accuracy	T = 85°C, V_{CC}= 3.0V	-1.5		1.5	%
	User calibration accuracy		-0.2		0.2	
	DFLL calibration step size			0.2		

33.3.13.4 32kHz Internal ULP Oscillator Characteristics

Table 33-80. 32kHz Internal ULP Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Factory calibrated frequency			32		kHz
	Factory calibration accuracy	T = 85°C, V_{CC}= 3.0V	-12		12	%
	Accuracy		-30		30	

33.5.6 ADC Characteristics

Table 33-124. Power Supply, Reference, and Input Range

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
AV_{CC}	Analog supply voltage		V_{CC}- 0.3		V_{CC}+ 0.3	V
V_{REF}	Reference voltage		1		AV_{CC}- 0.6	
R_{in}	Input resistance	Switched			4.5	kΩ
C_{in}	Input capacitance	Switched			5	pF
R_{AREF}	Reference input resistance	(leakage only)		>10		MΩ
C_{AREF}	Reference input capacitance	Static load		7		pF
Vin	Input range		0		V_{REF}	V
	Conversion range	Differential mode, Vinp - Vinn	$-V_{REF}$		V_{REF}	
	Conversion range	Single ended unsigned mode, Vinp	-ΔV		V_{REF}-ΔV	
ΔV	Fixed offset voltage			200		lsb

Table 33-125.Clock and Timing

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
Clk_{ADC}	ADC Clock frequency	Maximum is 1/4 of peripheral clock frequency	100		1800	kHz
		Measuring internal signals	100		125	
f_{ClkADC}	Sample rate		16		300	ksps
f_{ADC}	Sample rate	Current limitation (CURRLIMIT) off	16		300	
		CURRLIMIT = LOW	16		250	
		CURRLIMIT = MEDIUM	16		150	
		CURRLIMIT = HIGH	16		50	
	Sampling time	Configurable in steps of 1/2 Clk_{ADC} cycles up to 32 Clk_{ADC} cycles	0.28		320	µs
	Conversion time (latency)	(RES+2)/2+1+ GAIN RES (Resolution) = 8 or 12, GAIN=0 to 3	5.5		10	Clk_{ADC} cycles
	Start-up time	ADC clock cycles		12	24	
	ADC settling time	After changing reference or input mode		7	7	

33.5.13 Clock and Oscillator Characteristics

33.5.13.1 Calibrated 32.768kHz Internal Oscillator Characteristics

Table 33-135. 32.768kHz Internal Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Frequency			32.768		kHz
	Factory calibration accuracy	T = 85°C, V_{CC} = 3.0V	-0.5		0.5	%
	User calibration accuracy		-0.5		0.5	

33.5.13.2 Calibrated 2MHz RC Internal Oscillator Characteristics

Table 33-136. 2MHz Internal Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Frequency range	DFLL can tune to this frequency over voltage and temperature	1.8	2.0	2.2	MHz
	Factory calibrated frequency			2.0		
	Factory calibration accuracy	T = 85°C, V_{CC}= 3.0V	-1.5		1.5	%
	User calibration accuracy		-0.2		0.2	
	DFLL calibration stepsize			0.18		

33.5.13.3 Calibrated and Tunable 32MHz Internal Oscillator Characteristics

Table 33-137. 32MHz Internal Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Frequency range	DFLL can tune to this frequency over voltage and temperature	30	32	55	MHz
	Factory calibrated frequency			32		
	Factory calibration accuracy	T = 85°C, V_{CC}= 3.0V	-1.5		1.5	%
	User calibration accuracy		-0.2		0.2	
	DFLL calibration step size			0.19		

33.5.13.4 32kHz Internal ULP Oscillator Characteristics

Table 33-138. 32kHz Internal ULP Oscillator Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
	Factory calibrated frequency			32		kHz
	Factory calibration accuracy	T = 85°C, V_{CC}= 3.0V	-12		12	%
	Accuracy		-30		30	

Figure 34-39. Offset Error vs. V_{REF}

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

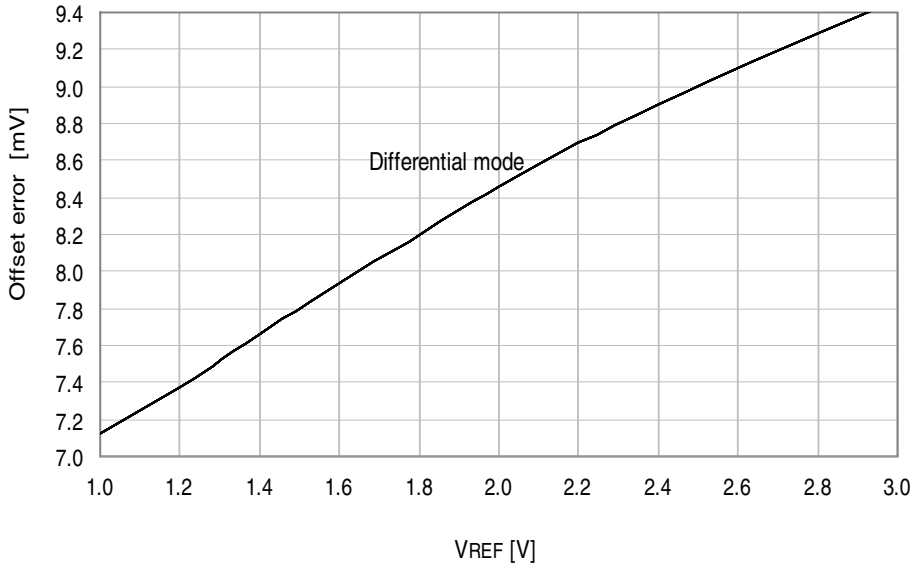
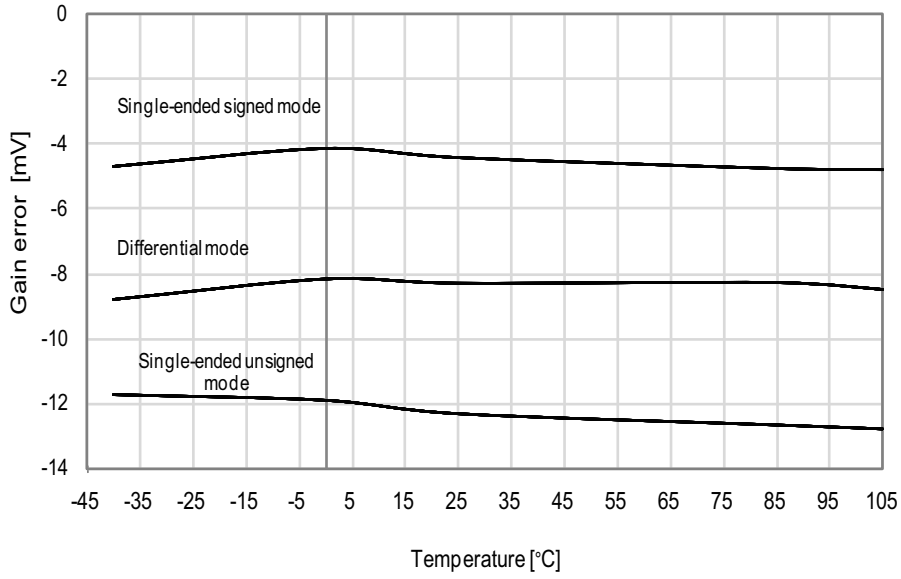


Figure 34-40. Gain Error vs. Temperature

V_{CC} = 3.0V, V_{REF} = external 2.0V



34.2.2 I/O Pin Characteristics

34.2.2.1 Pull-up

Figure 34-90. I/O Pin Pull-up Resistor Current vs. Input Voltage

V_{CC} = 1.8VC

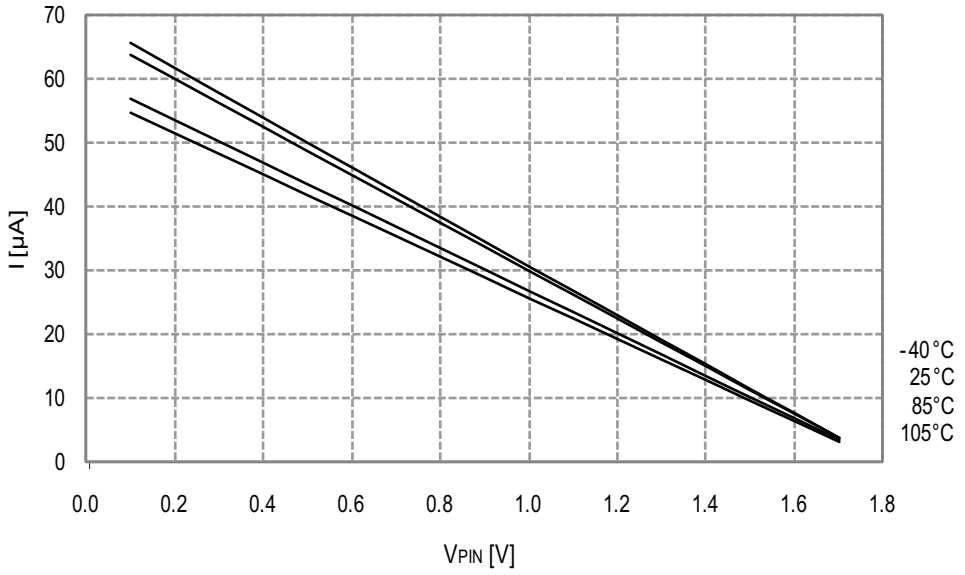


Figure 34-91. I/O Pin Pull-up Resistor Current vs. Input Voltage

V_{CC} = 3.0V

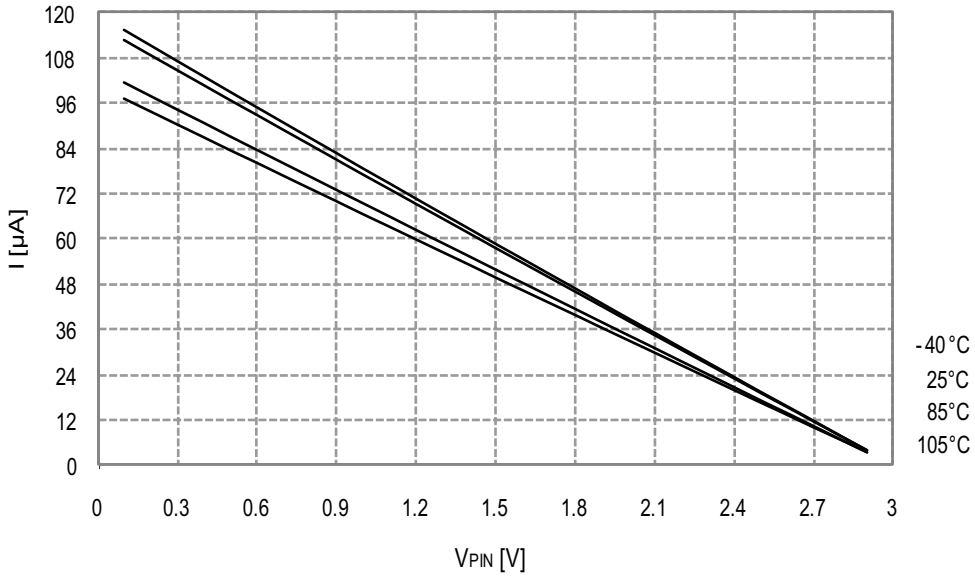


Figure 34-132. 32MHz Internal Oscillator Frequency vs. Temperature

DFLL enabled, from the 32.768kHz internal oscillator

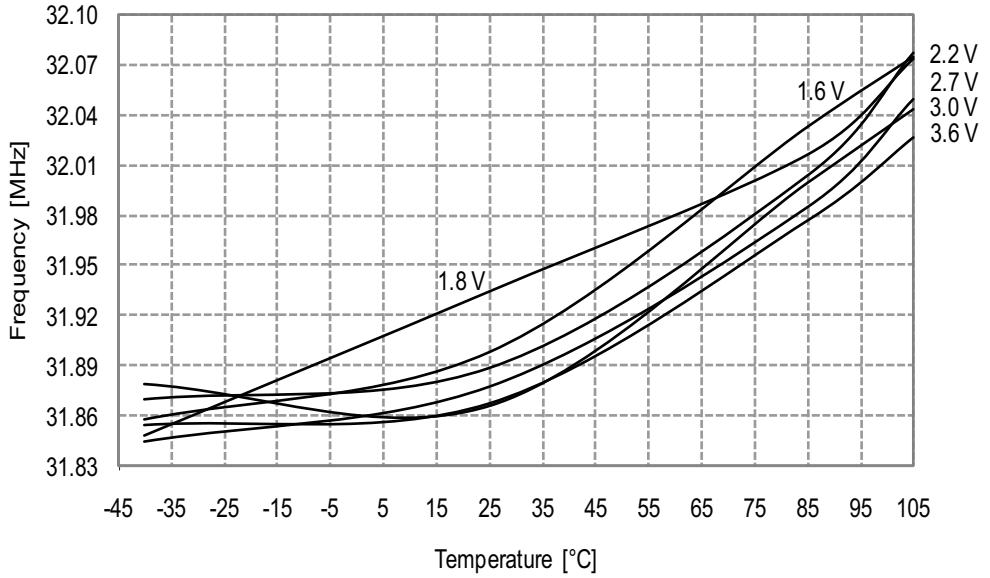


Figure 34-133. 32MHz Internal Oscillator CALA Calibration Step Size

T = -40°C, V_{CC} = 3.0V

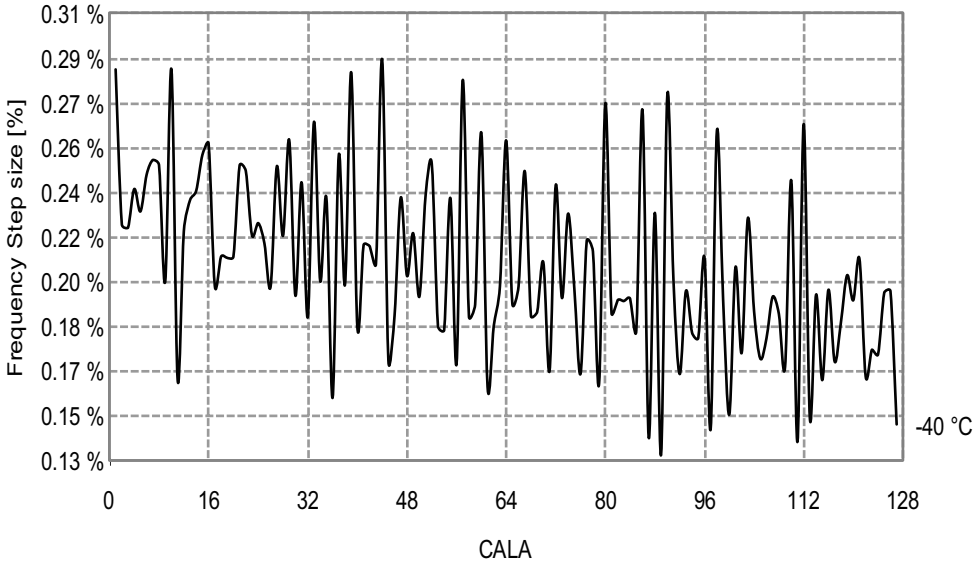
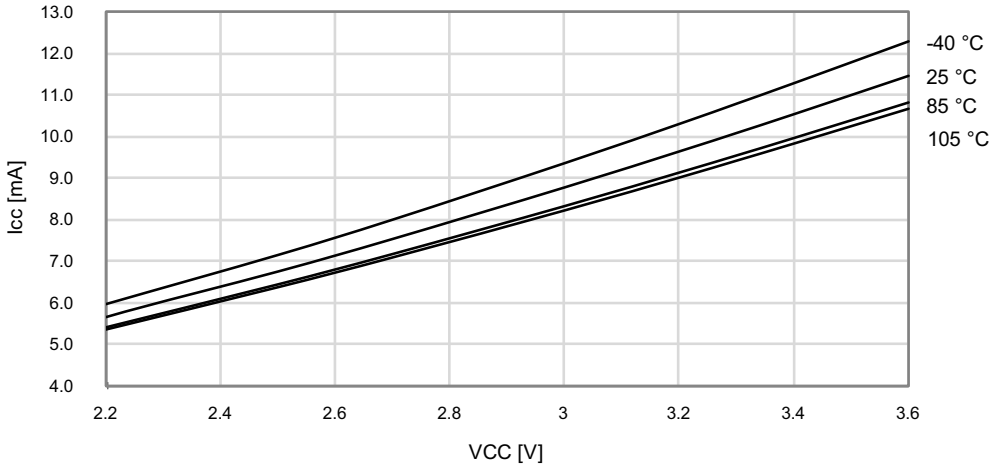


Figure 34-149. Active Mode Supply Current vs. V_{CC}

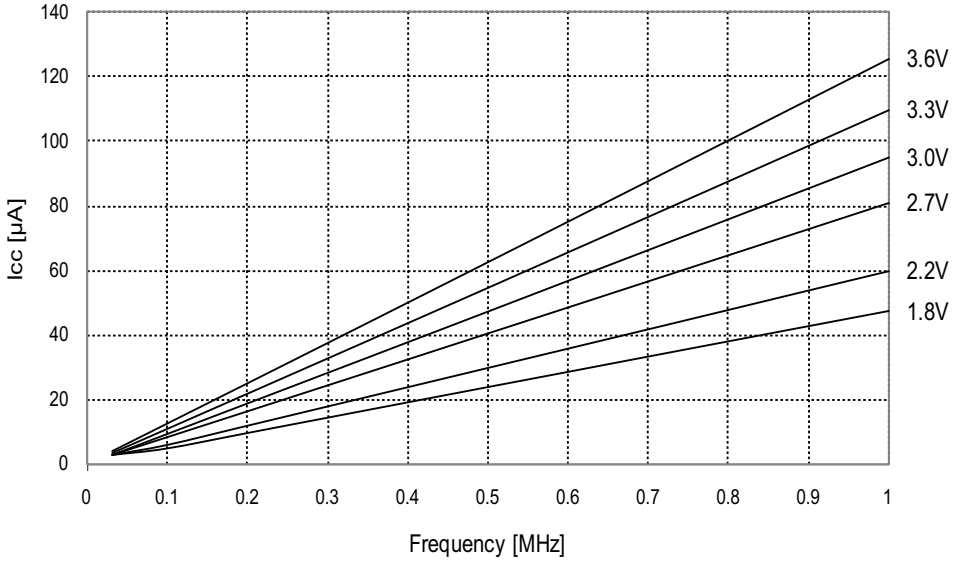
f_{SYS} = 32MHz internal oscillator



34.3.1.2 Idle Mode Supply Current

Figure 34-150. Idle Mode Supply Current vs. Frequency

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



34.3.2.3 Thresholds and Hysteresis

Figure 34-169. I/O Pin Input Threshold Voltage vs. V_{CC}

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

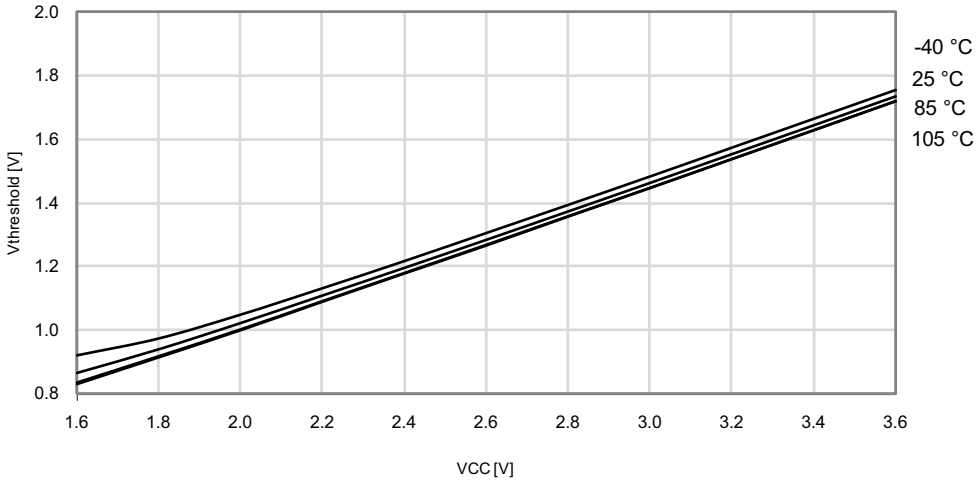


Figure 34-170. I/O Pin Input Threshold Voltage vs. V_{CC}

V_{IL} I/O pin read as "0"

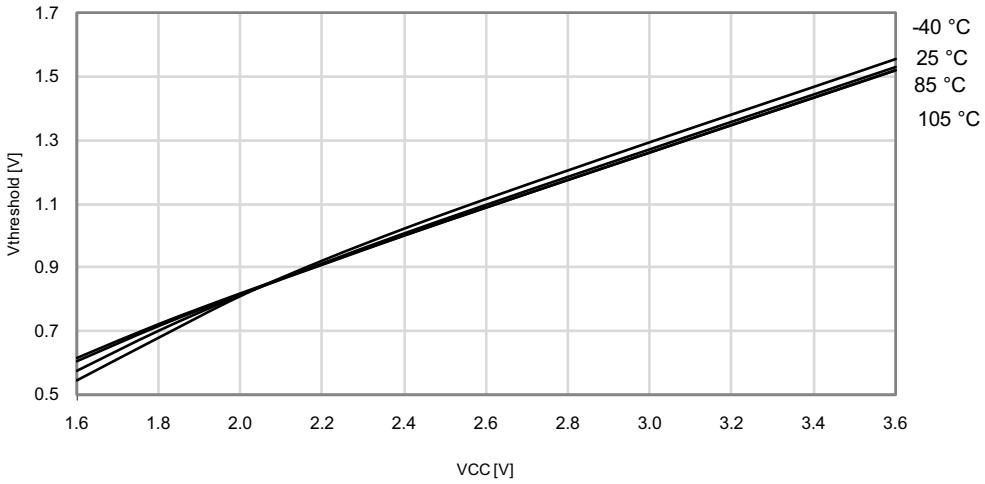
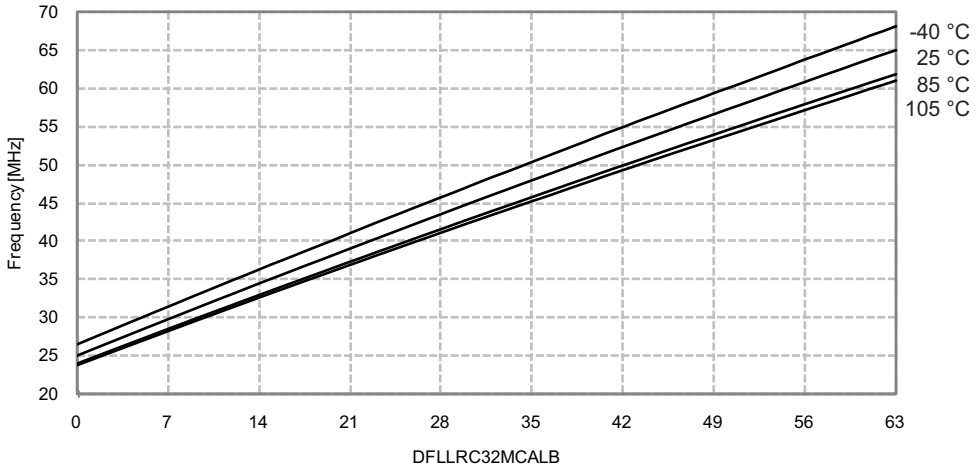


Figure 34-207. 32MHz Internal Oscillator Frequency vs. CALB Calibration Value

V_{CC} = 3.0V



34.3.8.5 32MHz Internal Oscillator Calibrated to 48MHz

Figure 34-208. 48MHz Internal Oscillator Frequency vs. Temperature

DFLL disabled

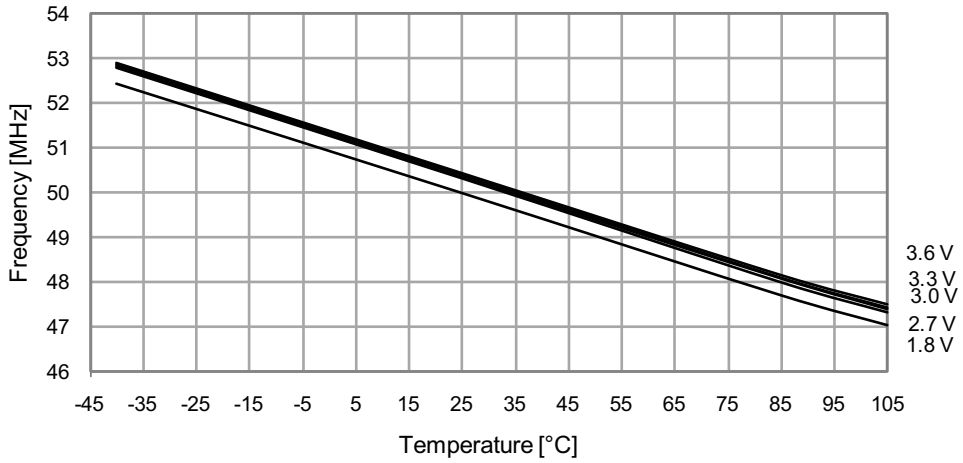


Figure 34-321. Gain Error vs. Temperature

V_{CC} = 3.0V, V_{REF} = external 2.0V

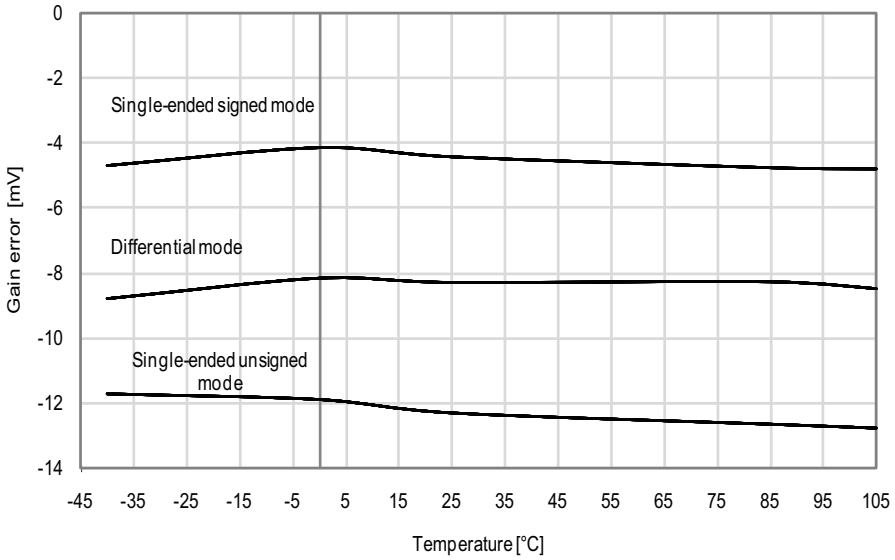


Figure 34-322. Offset Error vs. V_{CC}

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

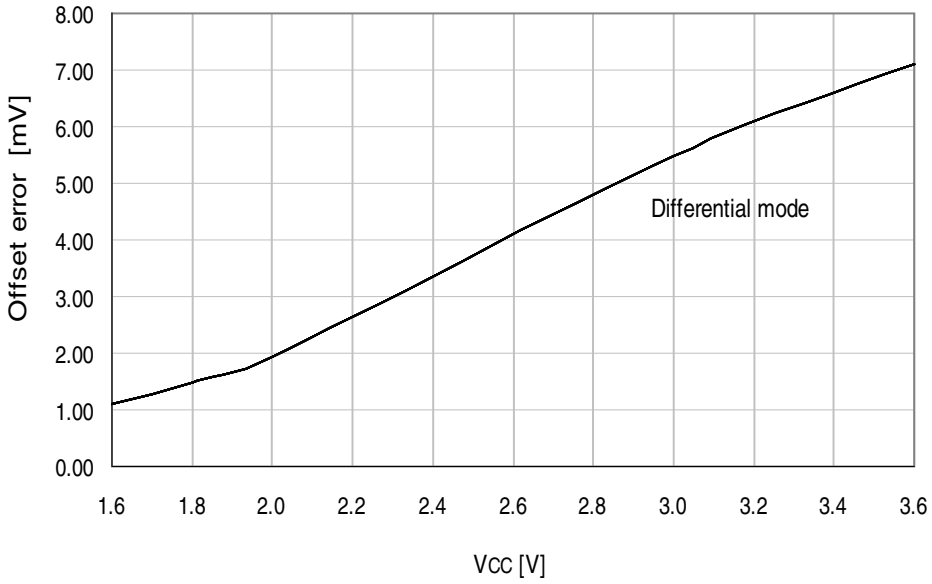


Figure 34-325. Analog Comparator Current Source vs. Calibration Value

V_{CC} = 3.0V

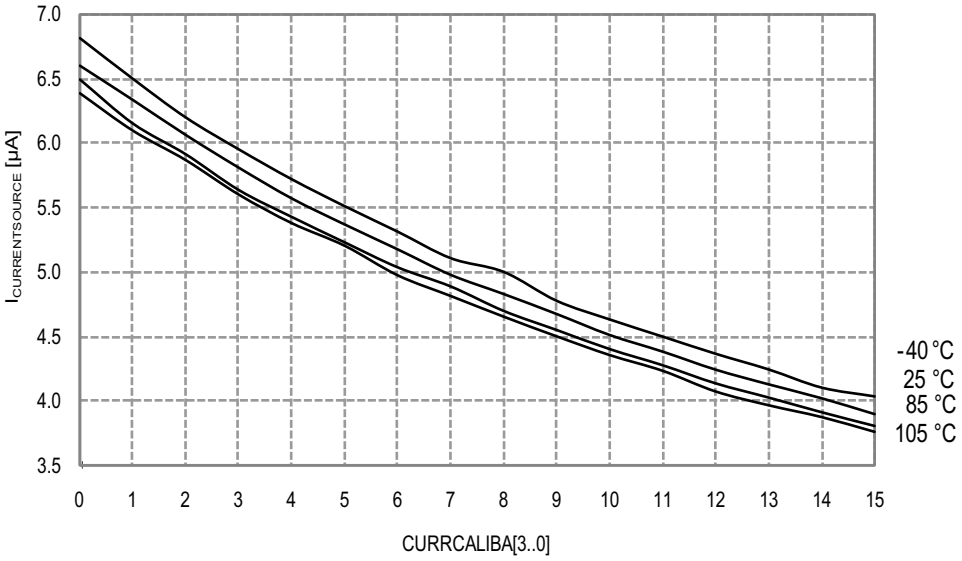


Figure 34-326. Voltage Scaler INL vs. SCALEFAC

T = 25°C, V_{CC} = 3.0V

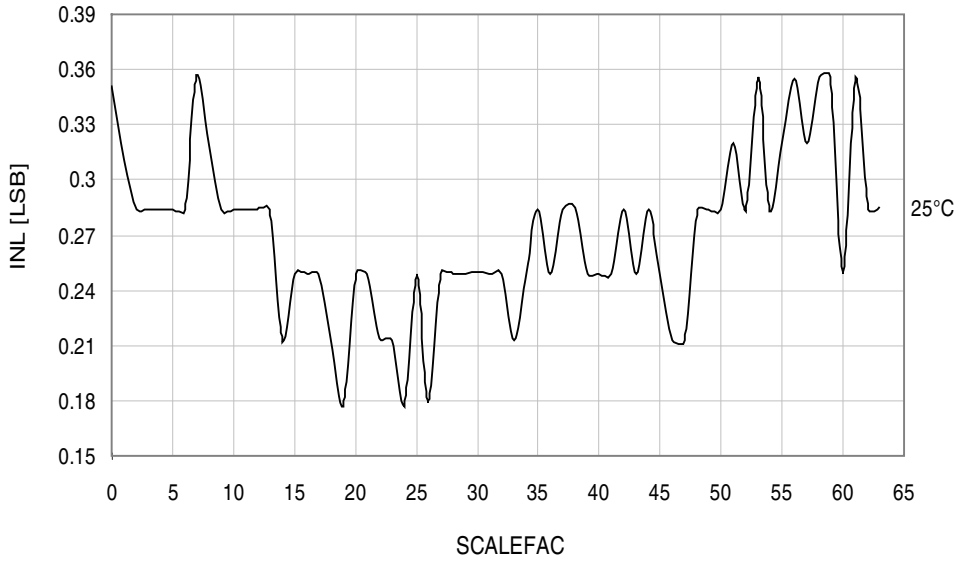


Figure 34-345. 32MHz Internal Oscillator CALA Calibration Step Size

T = 85°C, V_{CC} = 3.0V

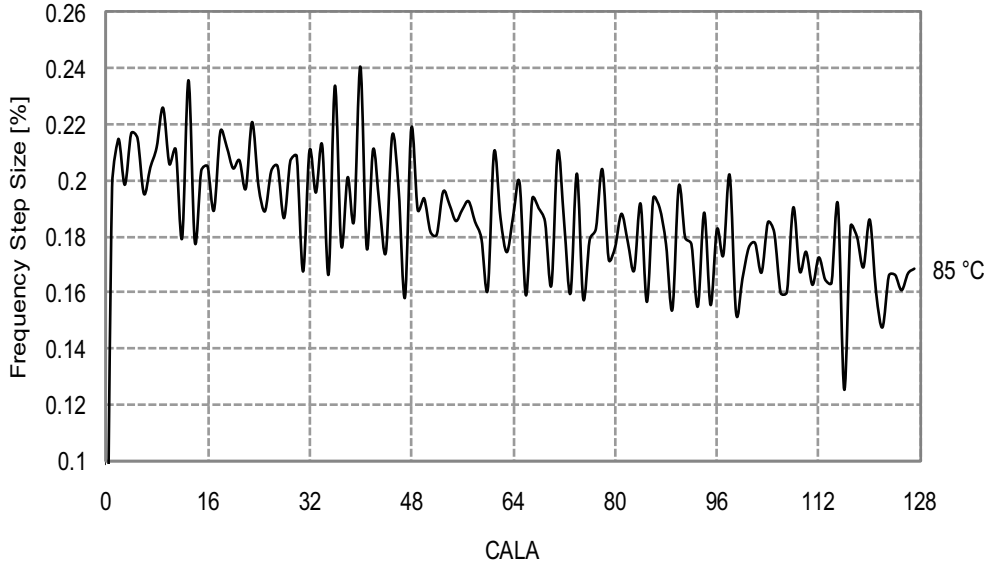


Figure 34-346. 32MHz Internal Oscillator CALA Calibration Step Size

T = 105°C, V_{CC} = 3.0V