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"[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	Discontinued at Digi-Key
Core Processor	ARM® Cortex®-M0+
Core Size	32-Bit Single-Core
Speed	25MHz
Connectivity	I ² C, IrDA, SmartCard, SPI, UART/USART, USB
Peripherals	Brown-out Detect/Reset, DMA, I ² S, POR, PWM, WDT
Number of I/O	22
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	1.98V ~ 3.8V
Data Converters	A/D 4x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	32-VQFN Exposed Pad
Supplier Device Package	32-QFN (6x6)
Purchase URL	https://www.e-xfl.com/product-detail/silicon-labs/efm32hg310f32g-a-qfn32r

3 Electrical Characteristics

3.1 Test Conditions

3.1.1 Typical Values

The typical data are based on $T_{AMB}=25^{\circ}\text{C}$ and $V_{DD}=3.0\text{ V}$, as defined in Table 3.2 (p. 8), unless otherwise specified.

3.1.2 Minimum and Maximum Values

The minimum and maximum values represent the worst conditions of ambient temperature, supply voltage and frequencies, as defined in Table 3.2 (p. 8), unless otherwise specified.

3.2 Absolute Maximum Ratings

The absolute maximum ratings are stress ratings, and functional operation under such conditions are not guaranteed. Stress beyond the limits specified in Table 3.1 (p. 8) may affect the device reliability or cause permanent damage to the device. Functional operating conditions are given in Table 3.2 (p. 8).

Table 3.1. Absolute Maximum Ratings

Symbol	Parameter	Condition	Min	Typ	Max	Unit
T_{STG}	Storage temperature range		-40		150 ¹	$^{\circ}\text{C}$
T_S	Maximum soldering temperature	Latest IPC/JEDEC J-STD-020 Standard			260	$^{\circ}\text{C}$
V_{DDMAX}	External main supply voltage		0		3.8	V
V_{IOPIN}	Voltage on any I/O pin		-0.3		$V_{DD}+0.3$	V

¹Based on programmed devices tested for 10000 hours at 150°C . Storage temperature affects retention of preprogrammed calibration values stored in flash. Please refer to the Flash section in the Electrical Characteristics for information on flash data retention for different temperatures.

3.3 General Operating Conditions

3.3.1 General Operating Conditions

Table 3.2. General Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
T_{AMB}	Ambient temperature range	-40		85	$^{\circ}\text{C}$
V_{DDOP}	Operating supply voltage	1.98		3.8	V
f_{APB}	Internal APB clock frequency			25	MHz
f_{AHB}	Internal AHB clock frequency			25	MHz

Symbol	Parameter	Condition	Min	Typ	Max	Unit
		EM2 current with RTC prescaled to 1 Hz, 32.768 kHz LFRCO, $V_{DD}=3.0\text{ V}$, $T_{AMB}=85^{\circ}\text{C}$		1.6	3.50	μA
I_{EM3}	EM3 current	EM3 current (ULFRCO enabled, LFRCO/LFXO disabled), $V_{DD}=3.0\text{ V}$, $T_{AMB}=25^{\circ}\text{C}$		0.6	0.90	μA
		EM3 current (ULFRCO enabled, LFRCO/LFXO disabled), $V_{DD}=3.0\text{ V}$, $T_{AMB}=85^{\circ}\text{C}$		1.2	2.65	μA
I_{EM4}	EM4 current	$V_{DD}=3.0\text{ V}$, $T_{AMB}=25^{\circ}\text{C}$		0.02	0.035	μA
		$V_{DD}=3.0\text{ V}$, $T_{AMB}=85^{\circ}\text{C}$		0.18	0.480	μA

3.4.1 EM0 Current Consumption

Figure 3.1. EM0 Current consumption while executing prime number calculation code from flash with HFRCO running at 24 MHz

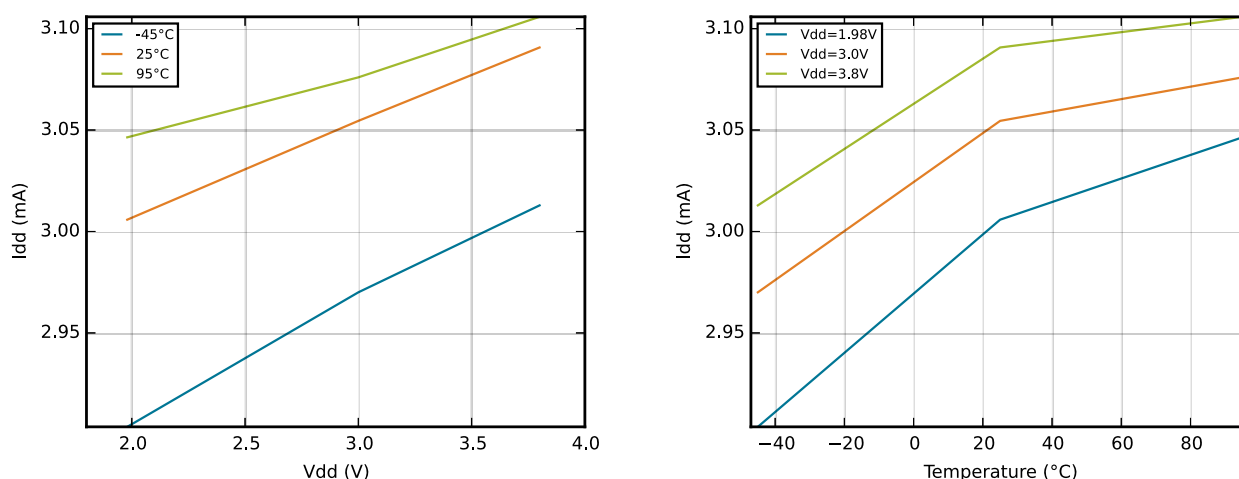


Figure 3.2. EM0 Current consumption while executing prime number calculation code from flash with HFRCO running at 21 MHz

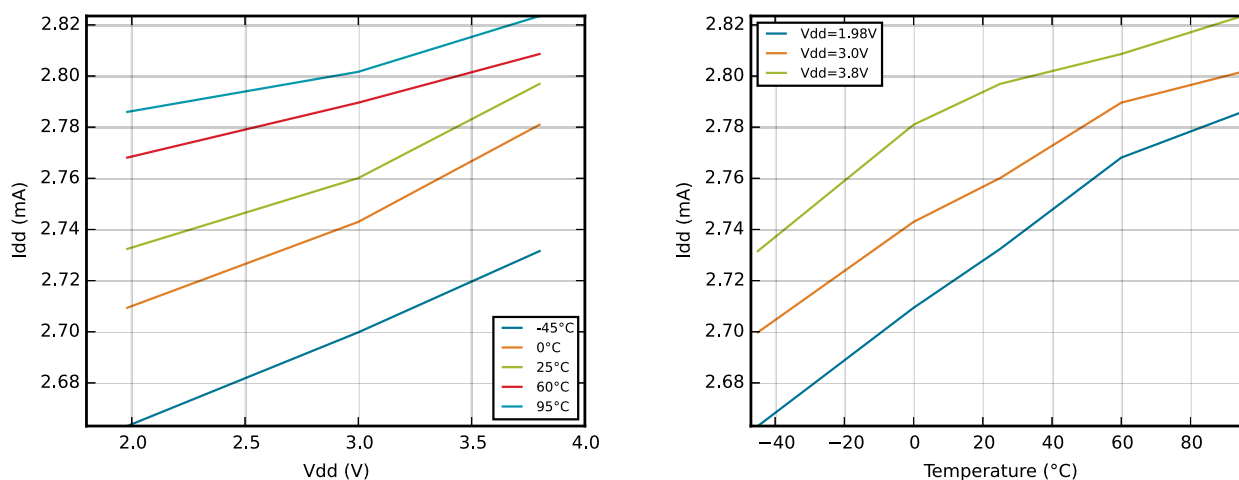


Figure 3.3. EM0 Current consumption while executing prime number calculation code from flash with HFRCO running at 14 MHz

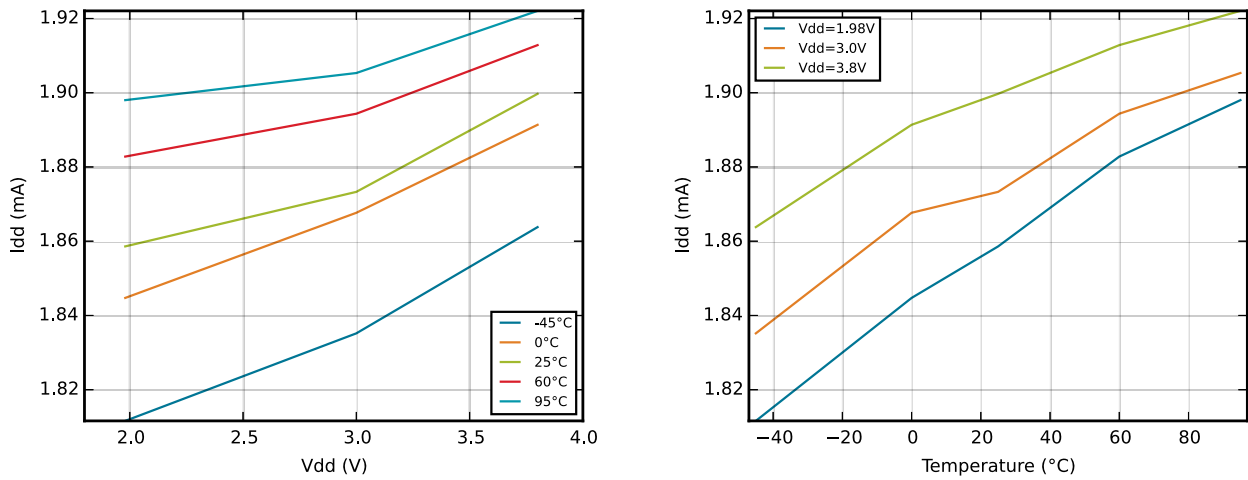


Figure 3.4. EM0 Current consumption while executing prime number calculation code from flash with HFRCO running at 11 MHz

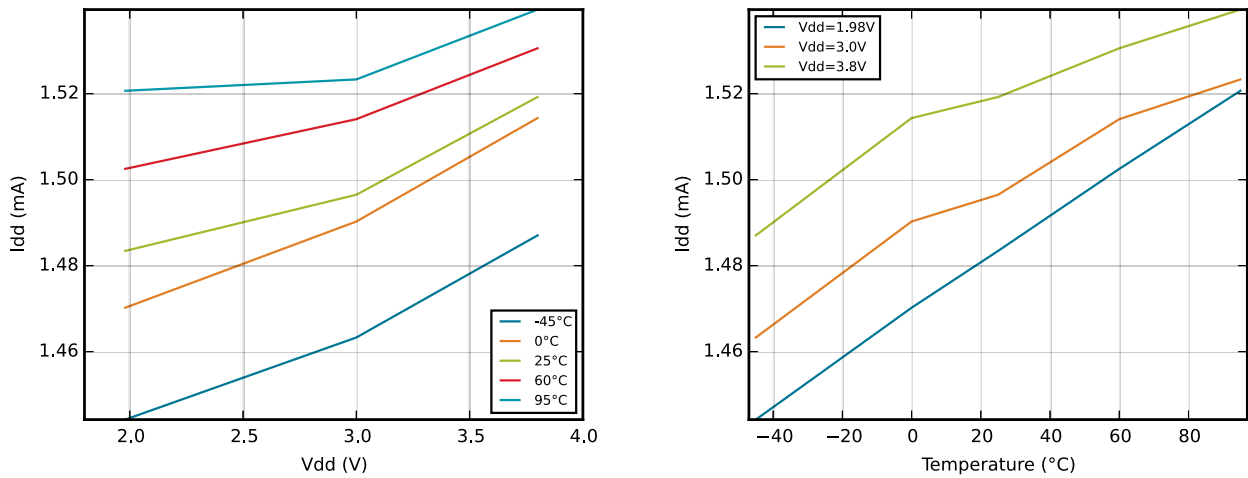


Figure 3.7. EM1 Current consumption with all peripheral clocks disabled and HFRCO running at 21 MHz

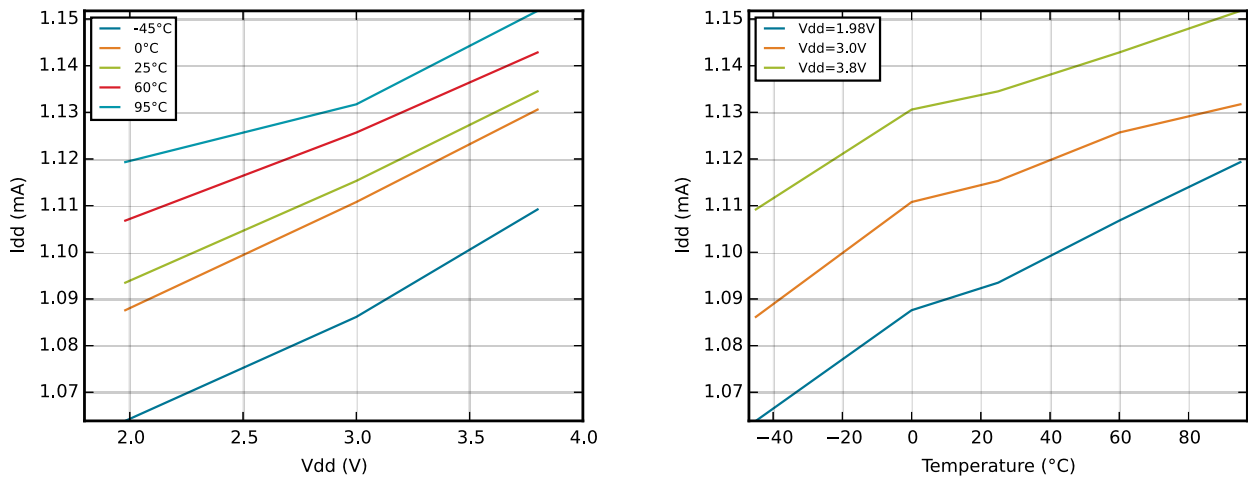
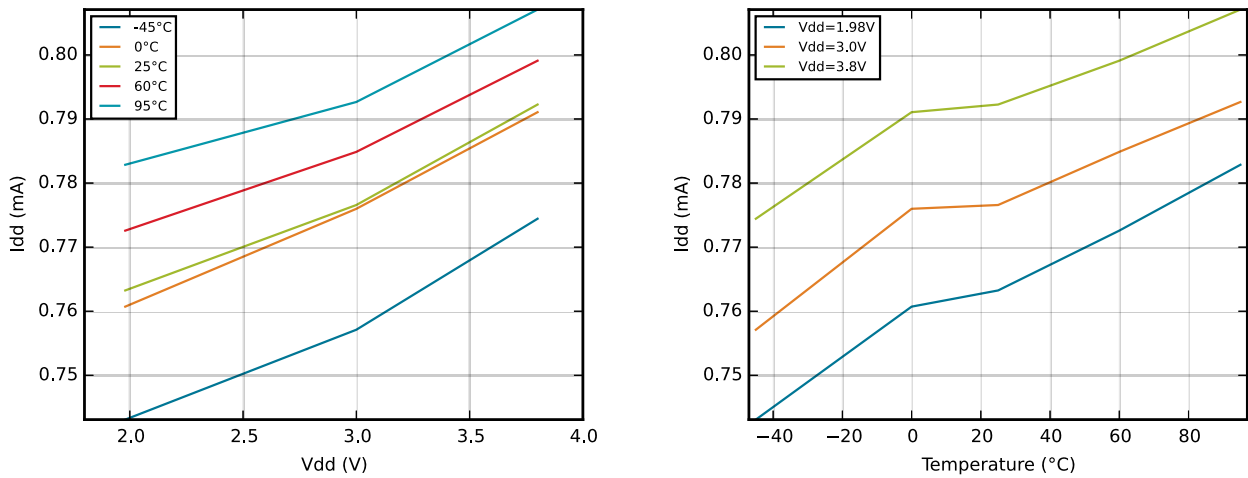
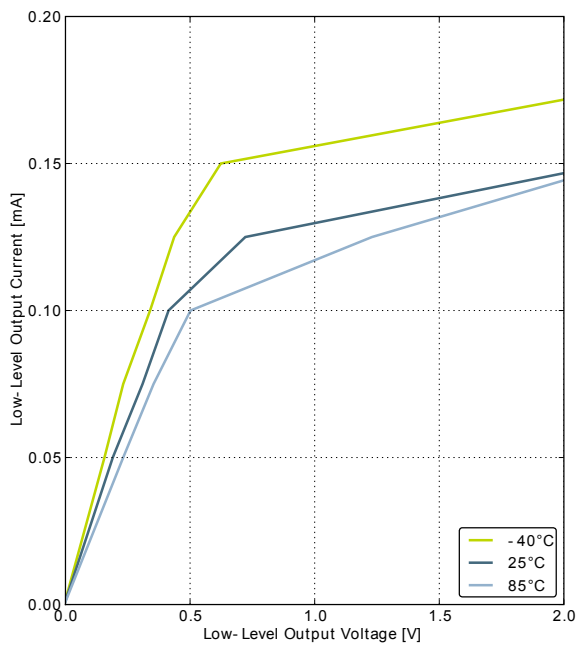


Figure 3.8. EM1 Current consumption with all peripheral clocks disabled and HFRCO running at 14 MHz

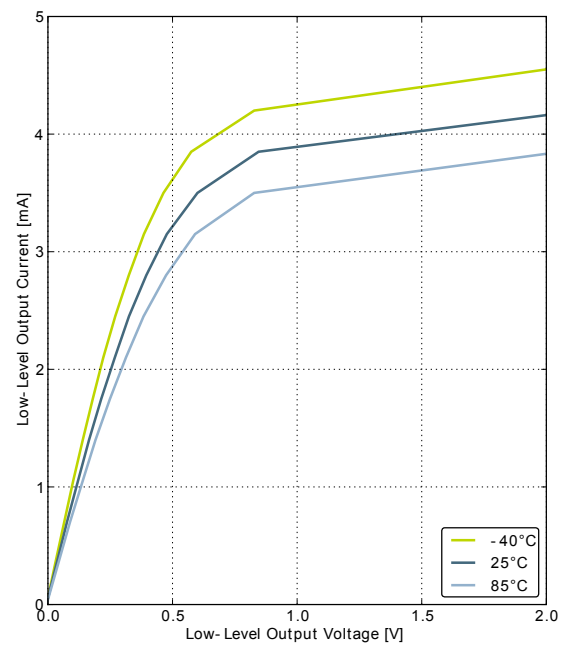


Symbol	Parameter	Condition	Min	Typ	Max	Unit
R _{PD}	I/O pin pull-down resistor			40		kOhm
R _{IOESD}	Internal ESD series resistor			200		Ohm
t _{IOGLITCH}	Pulse width of pulses to be removed by the glitch suppression filter		10		50	ns
t _{IOOF}	Output fall time	GPIO_Px_CTRL DRIVEMODE = LOWEST and load capacitance C _L =12.5-25pF.	20+0.1C _L		250	ns
		GPIO_Px_CTRL DRIVEMODE = LOW and load capacitance C _L =350-600pF	20+0.1C _L		250	ns
V _{IOHYST}	I/O pin hysteresis (V _{IOTHR+} - V _{IOTHR-})	V _{DD} = 1.98 - 3.8 V	0.1V _{DD}			V

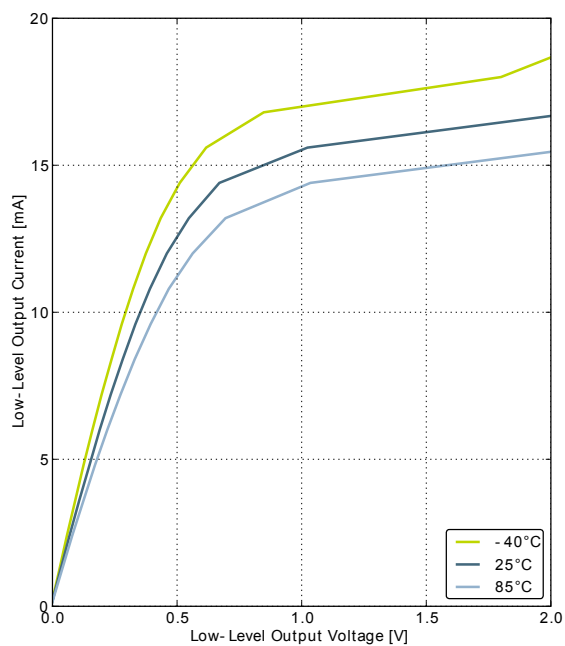
Figure 3.14. Typical Low-Level Output Current, 2V Supply Voltage



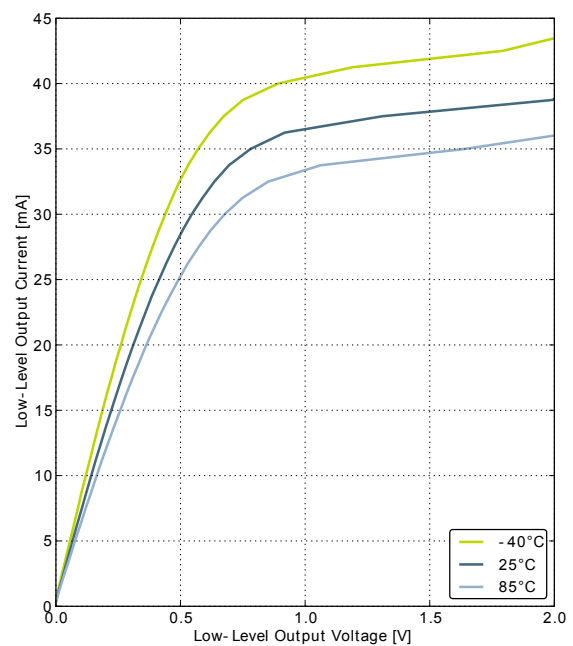
GPIO_Px_CTRL DRIVEMODE = LOWEST



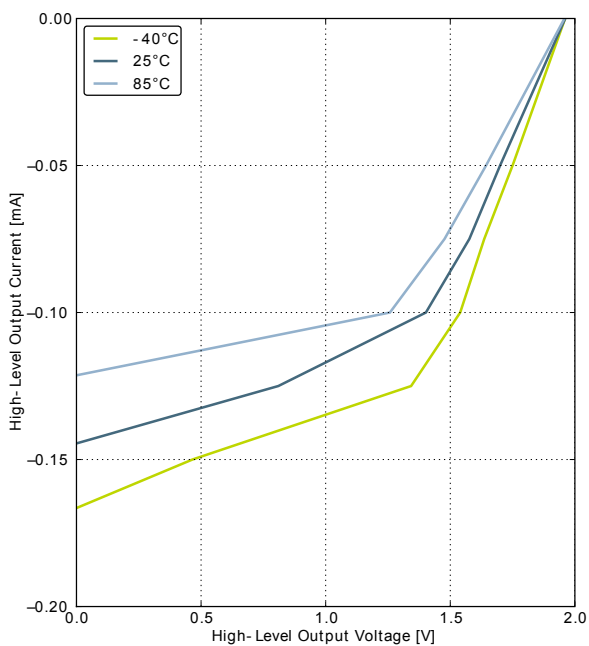
GPIO_Px_CTRL DRIVEMODE = LOW



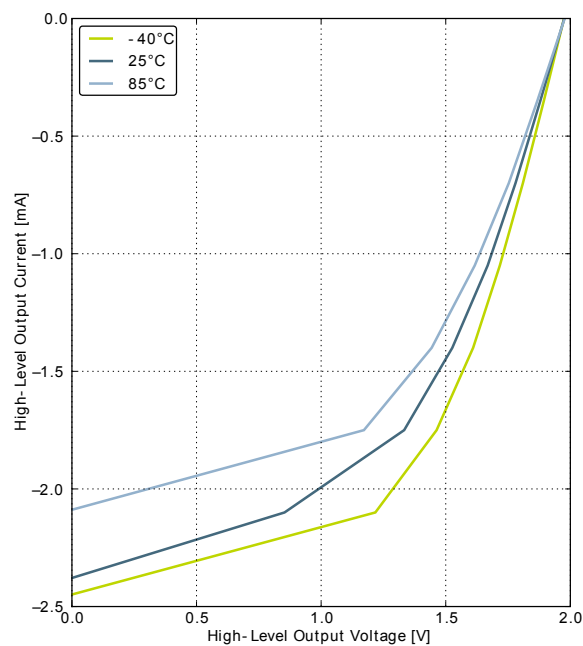
GPIO_Px_CTRL DRIVEMODE = STANDARD



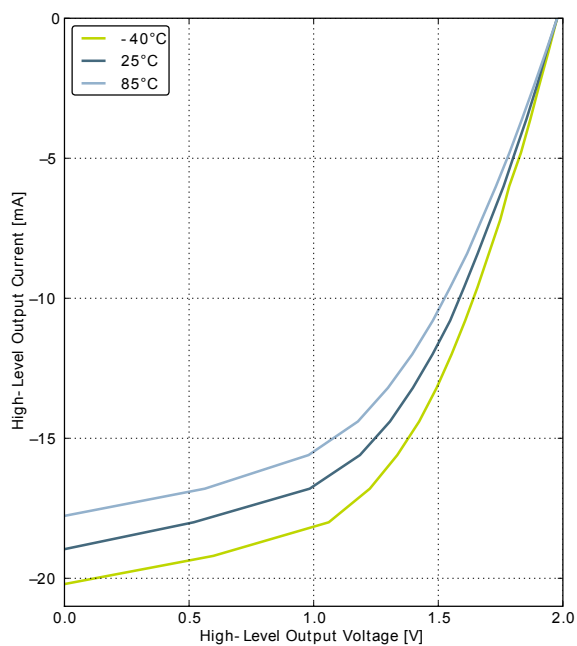
GPIO_Px_CTRL DRIVEMODE = HIGH

Figure 3.15. Typical High-Level Output Current, 2V Supply Voltage

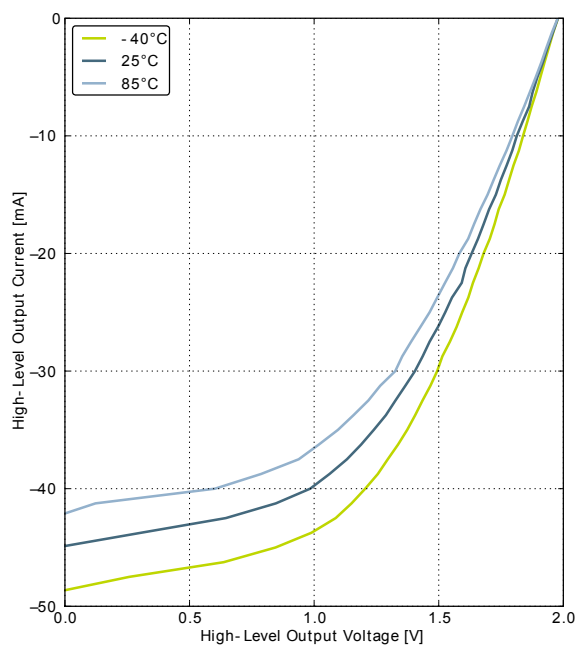
GPIO_Px_CTRL DRIVEMODE = LOWEST



GPIO_Px_CTRL DRIVEMODE = LOW

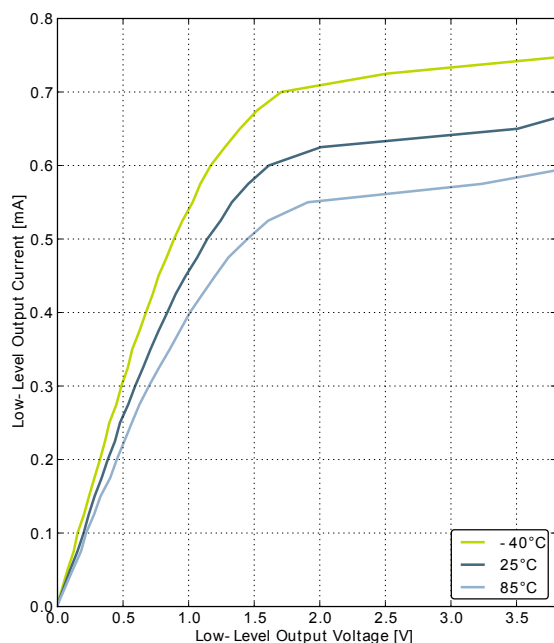


GPIO_Px_CTRL DRIVEMODE = STANDARD

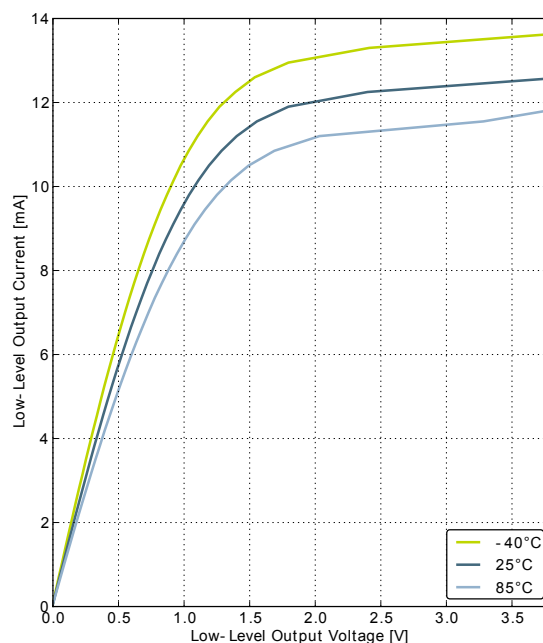


GPIO_Px_CTRL DRIVEMODE = HIGH

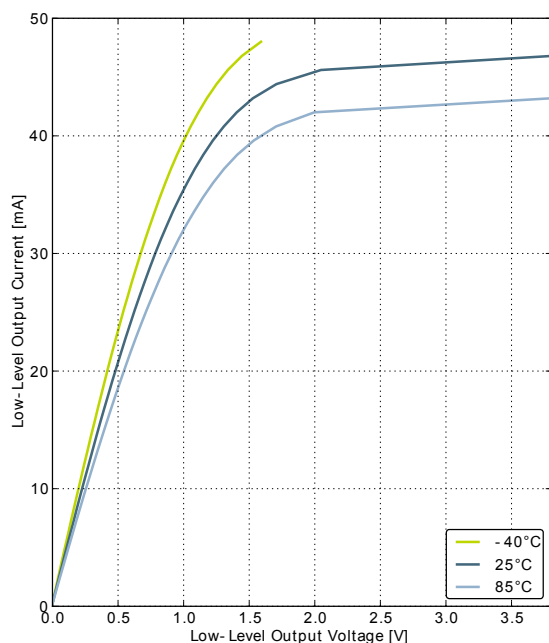
Figure 3.18. Typical Low-Level Output Current, 3.8V Supply Voltage



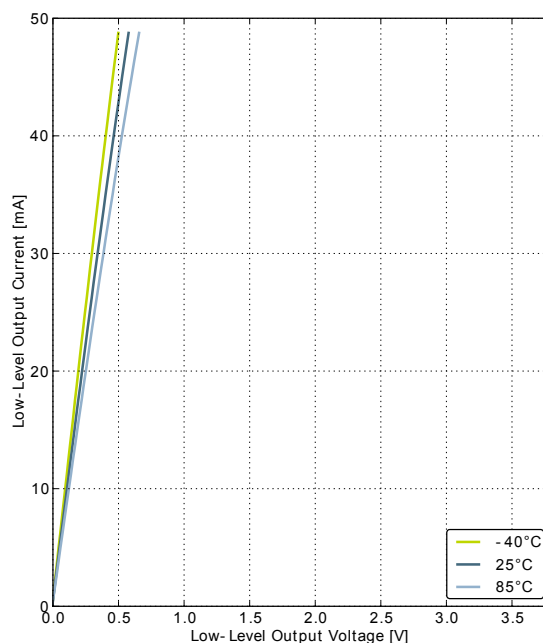
GPIO_Px_CTRL DRIVEMODE = LOWEST



GPIO_Px_CTRL DRIVEMODE = LOW



GPIO_Px_CTRL DRIVEMODE = STANDARD



GPIO_Px_CTRL DRIVEMODE = HIGH

3.9 Oscillators

3.9.1 LFXO

Table 3.8. LFXO

Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{LFXO}	Supported nominal crystal frequency			32.768		kHz
ESR_{LFXO}	Supported crystal equivalent series resistance (ESR)			30	120	kOhm
C_{LFXOL}	Supported crystal external load range		5		25	pF
I_{LFXO}	Current consumption for core and buffer after startup.	ESR=30 kOhm, C_L =10 pF, LFXOBOOST in CMU_CTRL is 1		190		nA
t_{LFXO}	Start- up time.	ESR=30 kOhm, C_L =10 pF, 40% - 60% duty cycle has been reached, LFXOBOOST in CMU_CTRL is 1		1100		ms

For safe startup of a given crystal, the Configurator tool in Simplicity Studio contains a tool to help users configure both load capacitance and software settings for using the LFXO. For details regarding the crystal configuration, the reader is referred to application note "AN0016 EFM32 Oscillator Design Consideration".

3.9.2 HFXO

Table 3.9. HFXO

Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{HFXO}	Supported frequency, any mode		4		25	MHz
ESR_{HFXO}	Supported crystal equivalent series resistance (ESR)	Crystal frequency 25 MHz		30	100	Ohm
		Crystal frequency 4 MHz		400	1500	Ohm
g_{mHFXO}	The transconductance of the HFXO input transistor at crystal startup	HFXOBOOST in CMU_CTRL equals 0b11	20			mS
C_{HFXOL}	Supported crystal external load range		5		25	pF
I_{HFXO}	Current consumption for HFXO after startup	4 MHz: ESR=400 Ohm, C_L =20 pF, HFXOBOOST in CMU_CTRL equals 0b11		85		μ A
		25 MHz: ESR=30 Ohm, C_L =10 pF, HFXOBOOST in CMU_CTRL equals 0b11		165		μ A
t_{HFXO}	Startup time	25 MHz: ESR=30 Ohm, C_L =10 pF, HFXOBOOST in CMU_CTRL equals 0b11		785		μ s

3.9.3 LFRCO

Table 3.10. LFRCO

Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{LFRCO}	Oscillation frequency, $V_{\text{DD}} = 3.0 \text{ V}$, $T_{\text{AMB}} = 25^\circ\text{C}$		31.3	32.768	34.3	kHz
t_{LFRCO}	Startup time not including software calibration			150		μs
I_{LFRCO}	Current consumption			361	492	nA
TUNESTEP _{LFRCO}	Frequency step for LSB change in TUNING value			202		Hz

Figure 3.20. Calibrated LFRCO Frequency vs Temperature and Supply Voltage

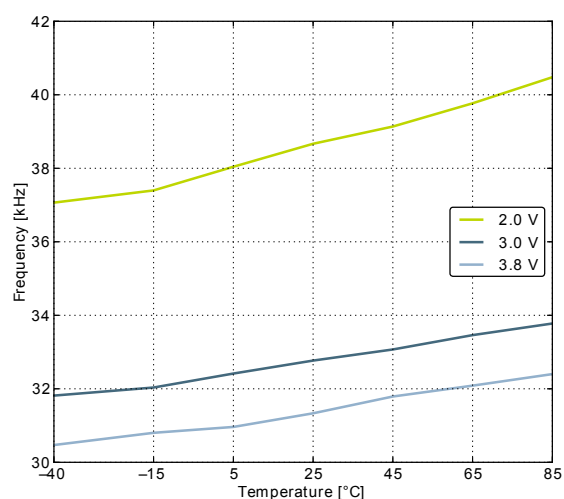
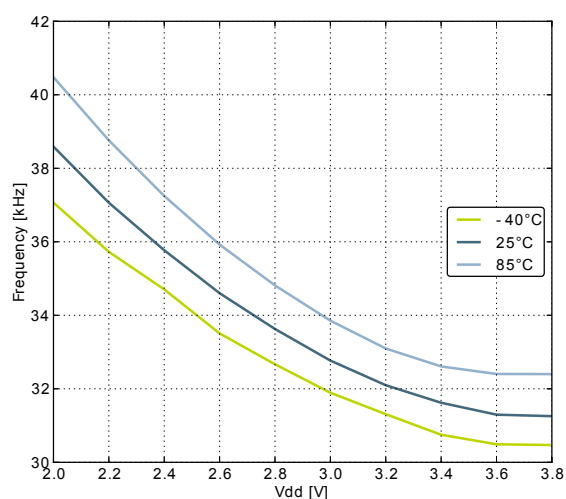
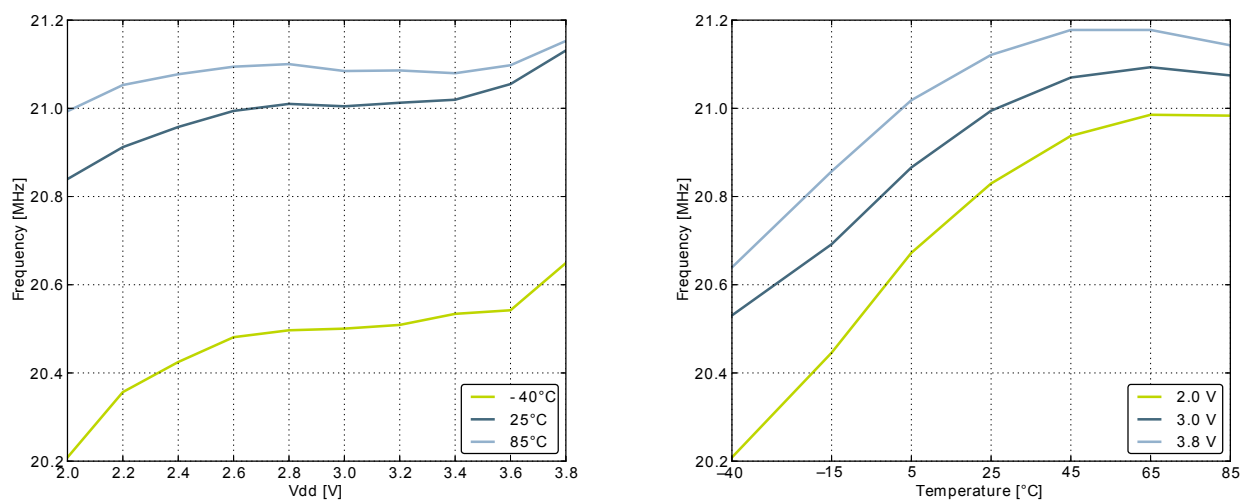


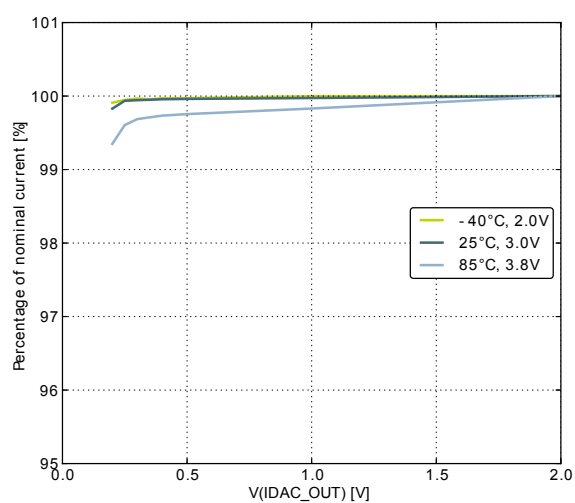
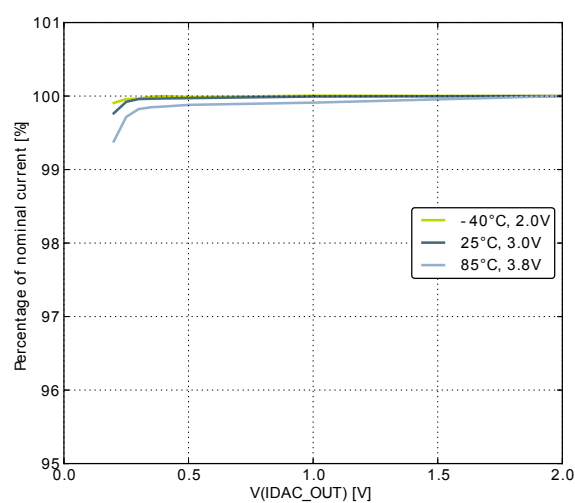
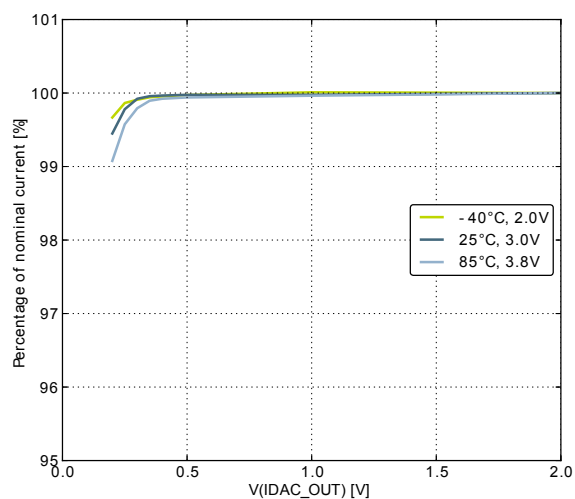
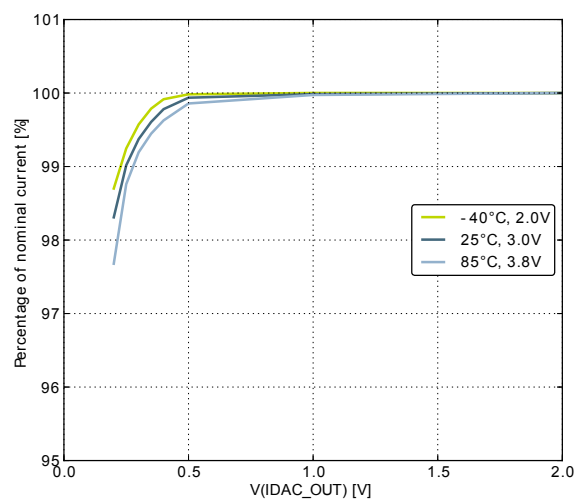
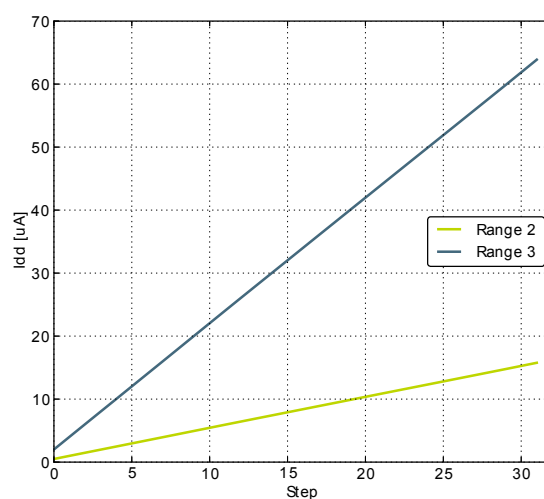
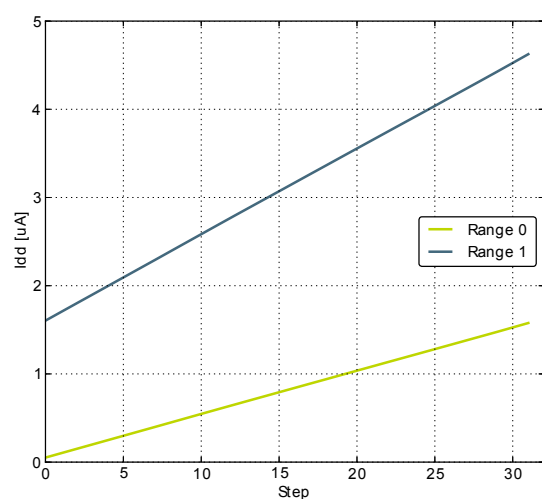
Figure 3.25. Calibrated HFRCO 21 MHz Band Frequency vs Supply Voltage and Temperature

3.9.5 AUXHFRCO

Table 3.12. AUXHFRCO

Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{AUXHFRCO}	Oscillation frequency, $V_{\text{DD}} = 3.0 \text{ V}$, $T_{\text{AMB}} = 25^\circ\text{C}$	21 MHz frequency band	20.37	21.0	21.63	MHz
		14 MHz frequency band	13.58	14.0	14.42	MHz
		11 MHz frequency band	10.67	11.0	11.33	MHz
		7 MHz frequency band	6.40	6.60	6.80	MHz
		1 MHz frequency band	1.15	1.20	1.25	MHz
$t_{\text{AUXHFRCO_settling}}$	Settling time after start-up	$f_{\text{AUXHFRCO}} = 14 \text{ MHz}$		0.6		Cycles
$\text{TUNESTEP}_{\text{AUXHFRCO}}$	Frequency step for LSB change in TUNING value	21 MHz frequency band		52.8		kHz
		14 MHz frequency band		36.9		kHz
		11 MHz frequency band		30.1		kHz
		7 MHz frequency band		18.0		kHz
		1 MHz frequency band		3.4		kHz

Symbol	Parameter	Condition	Min	Typ	Max	Unit
		1 MSamples/s, 12 bit, single ended, internal 2.5V reference		62		dB
		1 MSamples/s, 12 bit, single ended, V_{DD} reference		64		dB
		1 MSamples/s, 12 bit, differential, internal 1.25V reference		60		dB
		1 MSamples/s, 12 bit, differential, internal 2.5V reference		64		dB
		1 MSamples/s, 12 bit, differential, 5V reference		54		dB
		1 MSamples/s, 12 bit, differential, V_{DD} reference		66		dB
		1 MSamples/s, 12 bit, differential, $2xV_{DD}$ reference		68		dB
		200 kSamples/s, 12 bit, single ended, internal 1.25V reference		61		dB
		200 kSamples/s, 12 bit, single ended, internal 2.5V reference		65		dB
		200 kSamples/s, 12 bit, single ended, V_{DD} reference		66		dB
		200 kSamples/s, 12 bit, differential, internal 1.25V reference		63		dB
		200 kSamples/s, 12 bit, differential, internal 2.5V reference		66		dB
		200 kSamples/s, 12 bit, differential, 5V reference		66		dB
		200 kSamples/s, 12 bit, differential, V_{DD} reference	62	66		dB
		200 kSamples/s, 12 bit, differential, $2xV_{DD}$ reference		69		dB
SFDR _{ADC}	Spurious-Free Dynamic Range (SFDR)	1 MSamples/s, 12 bit, single ended, internal 1.25V reference		64		dBc
		1 MSamples/s, 12 bit, single ended, internal 2.5V reference		76		dBc
		1 MSamples/s, 12 bit, single ended, V_{DD} reference		73		dBc
		1 MSamples/s, 12 bit, differential, internal 1.25V reference		66		dBc
		1 MSamples/s, 12 bit, differential, internal 2.5V reference		77		dBc
		1 MSamples/s, 12 bit, differential, V_{DD} reference		76		dBc
		1 MSamples/s, 12 bit, differential, $2xV_{DD}$ reference		75		dBc
		1 MSamples/s, 12 bit, differential, 5V reference		69		dBc

Figure 3.35. IDAC Sink Current as a function of voltage from IDAC_OUT**Range 0****Range 1****Range 2****Range 3****Figure 3.36. IDAC linearity**

3.16 Digital Peripherals

Table 3.31. Digital Peripherals

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I _{USART}	USART current	USART idle current, clock enabled		7.5		μA/ MHz
I _{LEUART}	LEUART current	LEUART idle current, clock enabled		150		nA
I _{I2C}	I2C current	I2C idle current, clock enabled		6.25		μA/ MHz
I _{TIMER}	TIMER current	TIMER_0 idle current, clock enabled		8.75		μA/ MHz
I _{PCNT}	PCNT current	PCNT idle current, clock enabled		100		nA
I _{RTC}	RTC current	RTC idle current, clock enabled		100		nA
I _{AES}	AES current	AES idle current, clock enabled		2.5		μA/ MHz
I _{GPIO}	GPIO current	GPIO idle current, clock enabled		5.31		μA/ MHz
I _{PRS}	PRS current	PRS idle current		2.81		μA/ MHz
I _{DMA}	DMA current	Clock enable		8.12		μA/ MHz

Alternate	LOCATION							
Functionality	0	1	2	3	4	5	6	Description
US1_TX	PC0		PD7	PD7	PF2	PC1		USART1 Asynchronous Transmit. Also used as receive input in half duplex communication. USART1 Synchronous mode Master Output / Slave Input (MOSI).
USB_DM	PC14							USB D- pin.
USB_DMPU	PA0							USB D- Pullup control.
USB_DP	PC15							USB D+ pin.
USB_VREGI	USB_VREGI							USB Input to internal 3.3 V regulator
USB_VREGO	USB_VREGO							USB Decoupling for internal 3.3 V USB regulator and regulator output

4.3 GPIO Pinout Overview

The specific GPIO pins available in *EFM32HG310* is shown in Table 4.3 (p. 56) . Each GPIO port is organized as 16-bit ports indicated by letters A through F, and the individual pin on this port is indicated by a number from 15 down to 0.

Table 4.3. GPIO Pinout

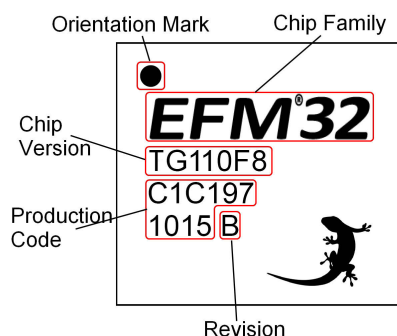
Port	Pin 15	Pin 14	Pin 13	Pin 12	Pin 11	Pin 10	Pin 9	Pin 8	Pin 7	Pin 6	Pin 5	Pin 4	Pin 3	Pin 2	Pin 1	Pin 0
Port A	-	-	-	-	-	-	-	-	-	-	-	-	-	PA2	PA1	PA0
Port B	-	PB14	PB13	-	PB11	-	-	PB8	PB7	-	-	-	-	-	-	-
Port C	PC15	PC14	-	-	-	-	-	-	-	-	-	-	-	-	PC1	PC0
Port D	-	-	-	-	-	-	-	-	PD7	PD6	PD5	-	-	-	-	-
Port E	-	-	PE13	PE12	PE11	PE10	-	-	-	-	-	-	-	-	-	-
Port F	-	-	-	-	-	-	-	-	-	-	-	-	-	PF2	PF1	PF0

6 Chip Marking, Revision and Errata

6.1 Chip Marking

In the illustration below package fields and position are shown.

Figure 6.1. Example Chip Marking (top view)



6.2 Revision

The revision of a chip can be determined from the "Revision" field in Figure 6.1 (p. 61) .

6.3 Errata

Please see the errata document for EFM32HG310 for description and resolution of device erratas. This document is available in Simplicity Studio and online at:

<http://www.silabs.com/support/pages/document-library.aspx?p=MCUs--32-bit>

A Disclaimer and Trademarks

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