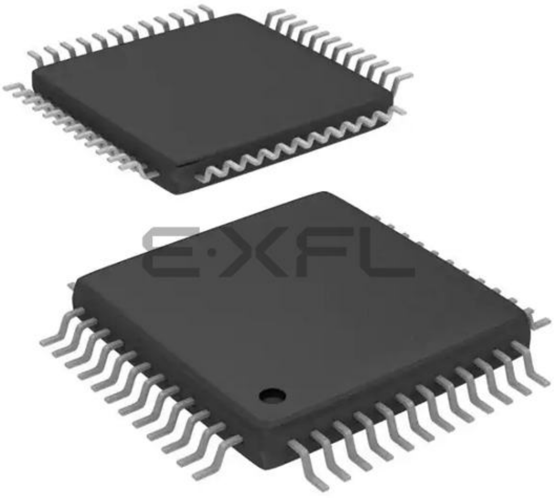
Silicon Labs - EFM32HG322F64G-A-QFP48R Datasheet



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	Discontinued at Digi-Key
Core Processor	ARM® Cortex®-M0+
Core Size	32-Bit Single-Core
Speed	25MHz
Connectivity	I²C, IrDA, SmartCard, SPI, UART/USART, USB
Peripherals	Brown-out Detect/Reset, DMA, I²S, POR, PWM, WDT
Number of I/O	35
Program Memory Size	64KB (64K 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	48-TQFP
Supplier Device Package	48-TQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/silicon-labs/efm32hg322f64g-a-qfp48r

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

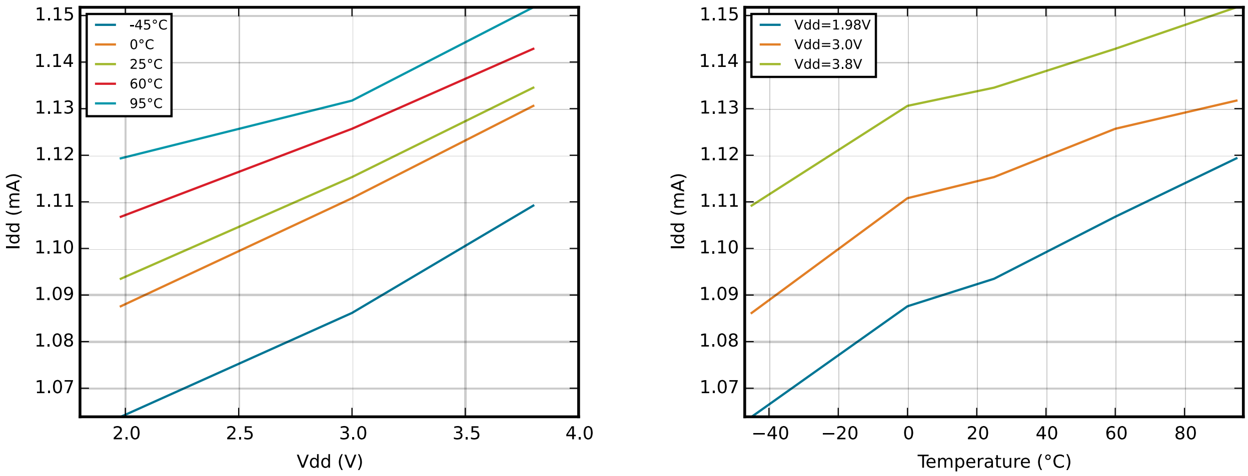
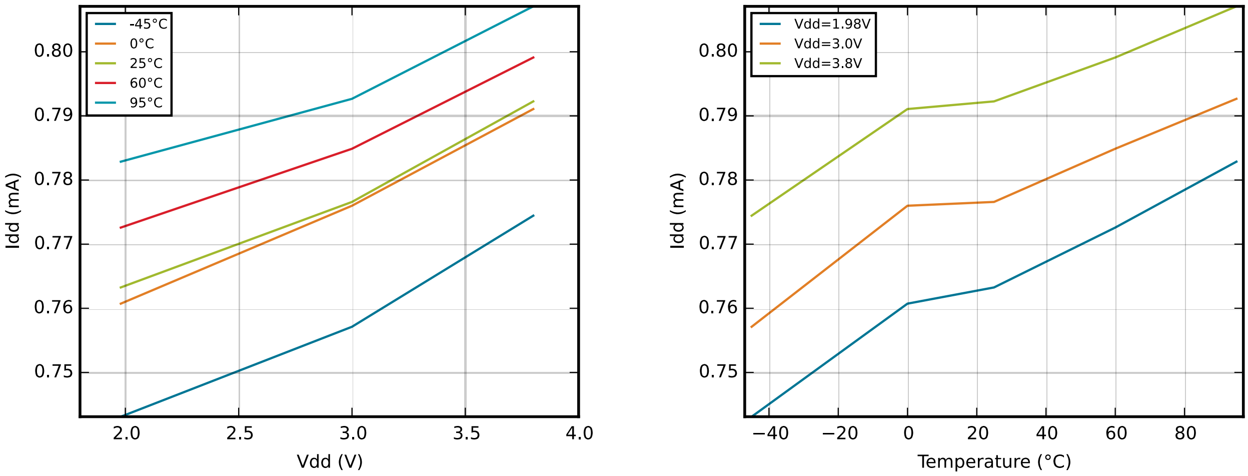
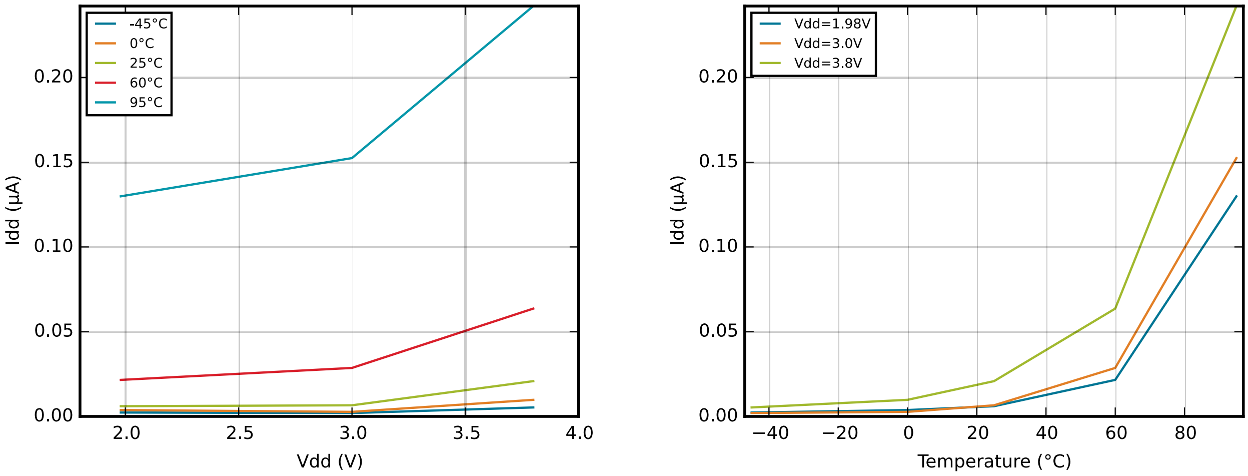


Figure 3.8. EM1 Current consumption with all peripheral clocks disabled and HFRCO running at 14 MHz



3.4.5 EM4 Current Consumption

Figure 3.13. EM4 current consumption.



3.5 Transition between Energy Modes

The transition times are measured from the trigger to the first clock edge in the CPU.

Table 3.4. Energy Modes Transitions

Symbol	Parameter	Min	Typ	Max	Unit
t_{EM10}	Transition time from EM1 to EM0		0		HF-CORE-CLK cycles
t_{EM20}	Transition time from EM2 to EM0		2		µs
t_{EM30}	Transition time from EM3 to EM0		2		µs
t_{EM40}	Transition time from EM4 to EM0		163		µs

3.6 Power Management

The EFM32HG requires the AVDD_x, VDD_DREG and IOVDD_x pins to be connected together (with optional filter) at the PCB level. For practical schematic recommendations, please see the application note, "AN0002 EFM32 Hardware Design Considerations".

Table 3.5. Power Management

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$V_{BODextthr-}$	BOD threshold on falling external supply voltage	EM0	1.74		1.96	V
		EM2	1.71	1.86	1.98	V
$V_{BODextthr+}$	BOD threshold on rising external supply voltage			1.85		V
t_{RESET}	Delay from reset is released until program execution starts	Applies to Power-on Reset, Brown-out Reset and pin reset.		163		µs
$C_{DECOUPLE}$	Voltage regulator decoupling capacitor.	X5R capacitor recommended. Apply between DECOUPLE pin and GROUND		1		µF
C_{USB_VREGO}	USB voltage regulator out decoupling capacitor.	X5R capacitor recommended. Apply between USB_VREGO pin and GROUND		1		µF
C_{USB_VREGI}	USB voltage regulator in decoupling capacitor.	X5R capacitor recommended. Apply between USB_VREGI pin and GROUND		4.7		µF

3.7 Flash

Table 3.6. Flash

Symbol	Parameter	Condition	Min	Typ	Max	Unit
EC_{FLASH}	Flash erase cycles before failure		20000			cycles
RET_{FLASH}	Flash data retention	T_{AMB}<150°C	10000			h
		T_{AMB}<85°C	10			years
		T_{AMB}<70°C	20			years
t_{W_PROG}	Word (32-bit) programming time		20			µs
t_{P_ERASE}	Page erase time		20	20.4	20.8	ms
t_{D_ERASE}	Device erase time		40	40.8	41.6	ms
I_{ERASE}	Erase current				7[1]	mA
I_{WRITE}	Write current				7[1]	mA
V_{FLASH}	Supply voltage during flash erase and write		1.98		3.8	V

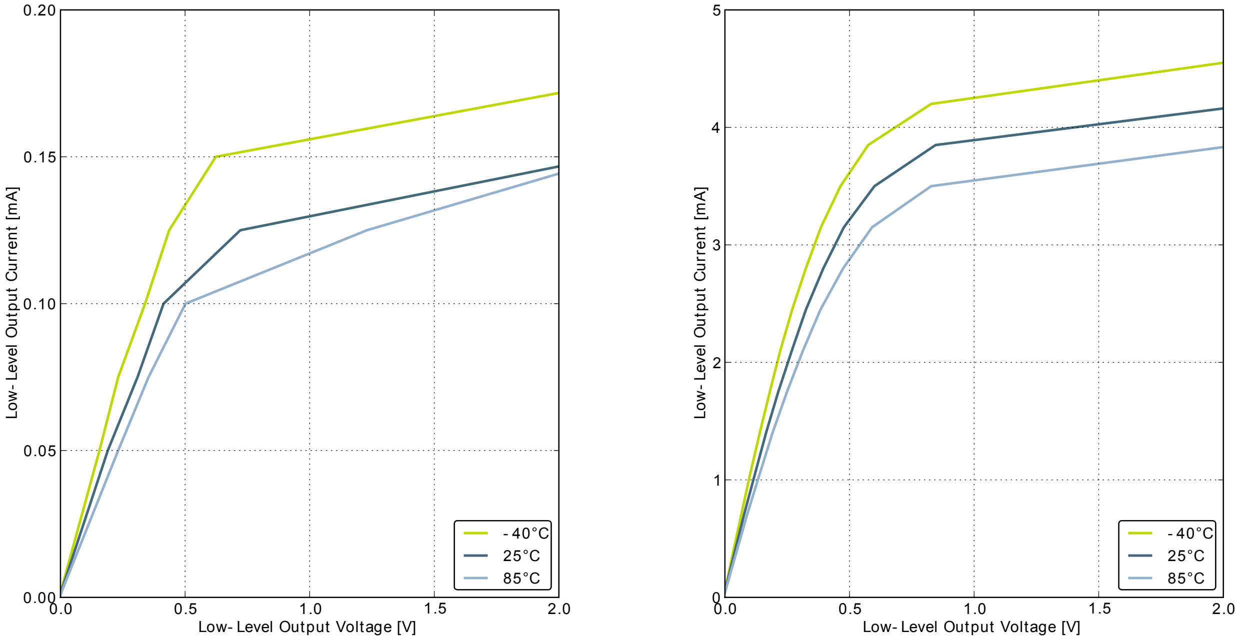
[1] Measured at 25°C

3.8 General Purpose Input Output

Table 3.7. GPIO

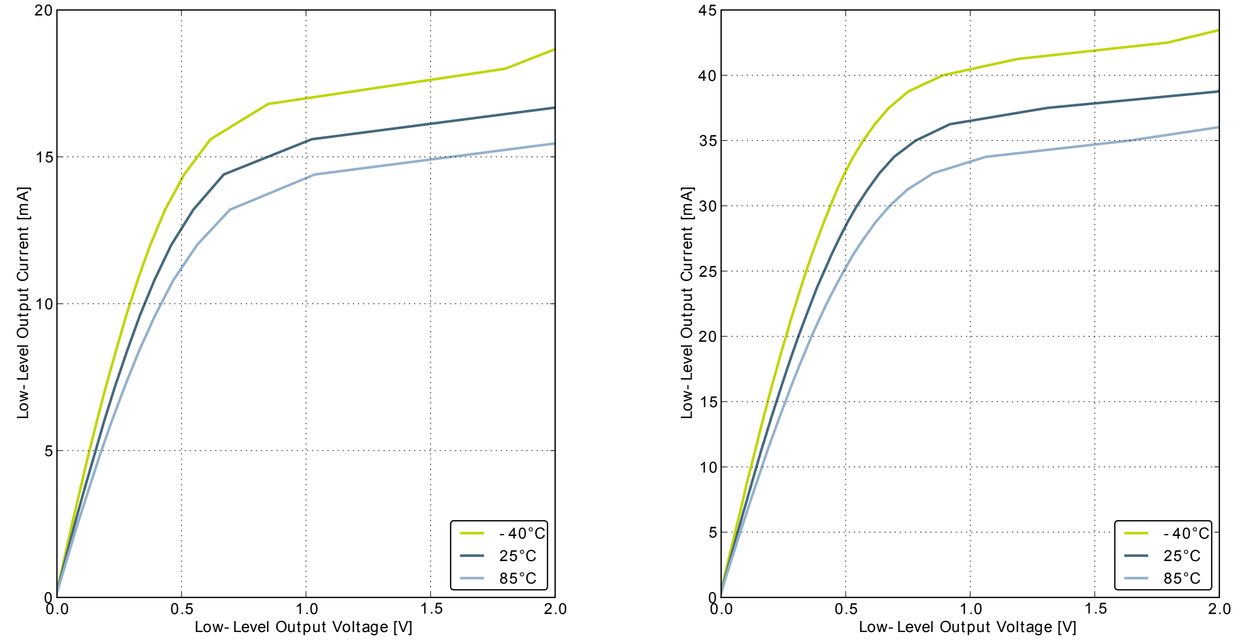
Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{IOIL}	Input low voltage				$0.30V_{DD}$	V
V_{IOIH}	Input high voltage		$0.70V_{DD}$			V

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



GPIO_Px_CTRL DRIVEMODE = LOWEST

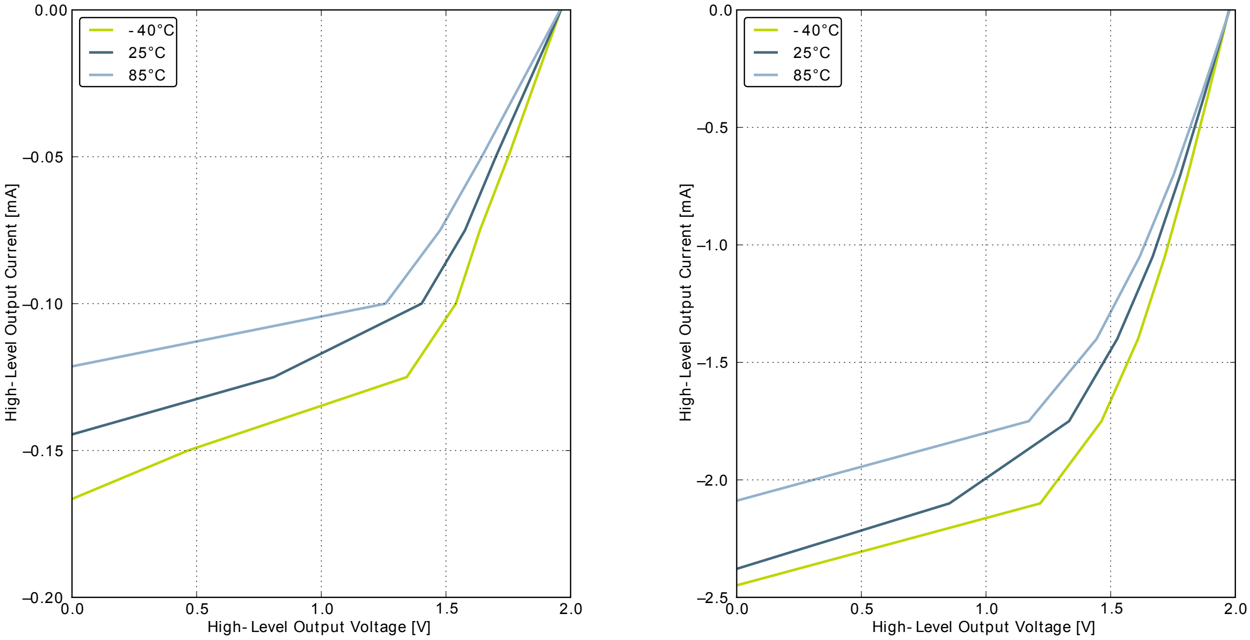
GPIO_Px_CTRL DRIVEMODE = LOW



GPIO_Px_CTRL DRIVEMODE = STANDARD

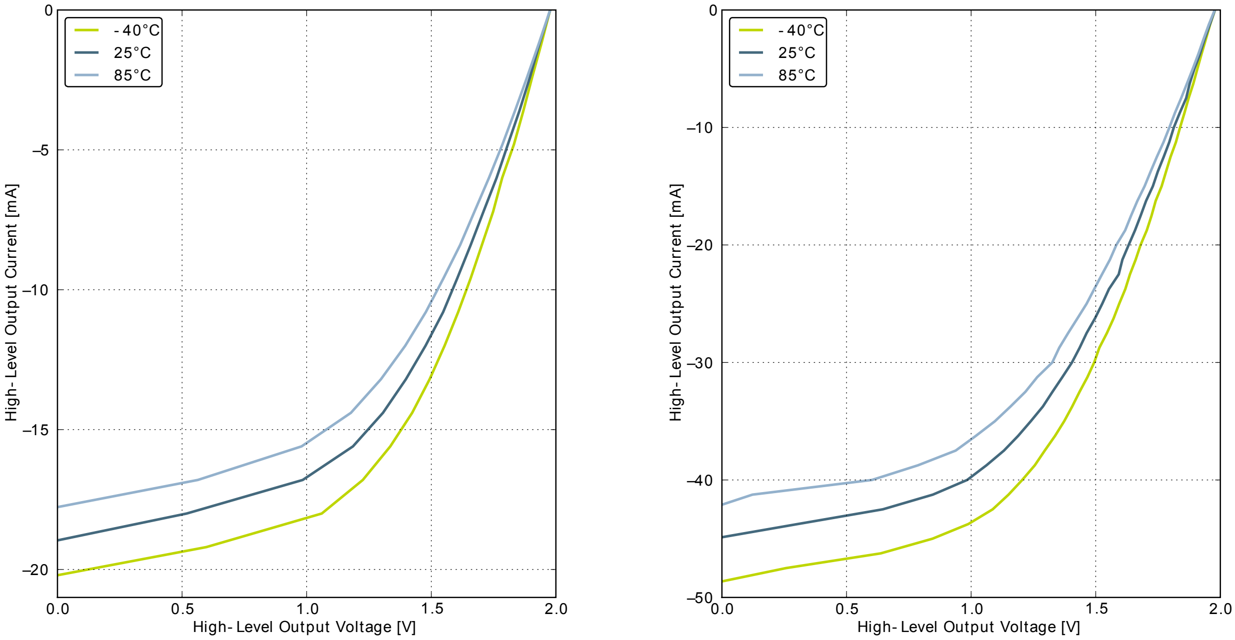
GPIO_Px_CTRL DRIVEMODE = HIGH

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



GPIO_Px_CTRL DRIVEMODE = LOWEST

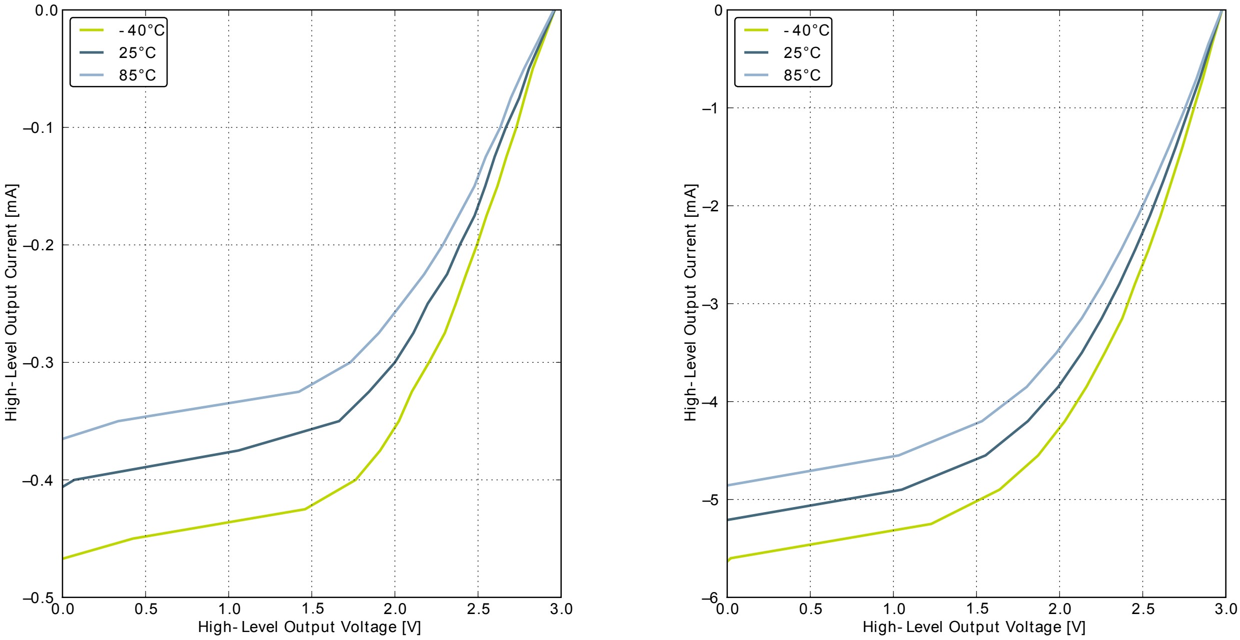
GPIO_Px_CTRL DRIVEMODE = LOW



GPIO_Px_CTRL DRIVEMODE = STANDARD

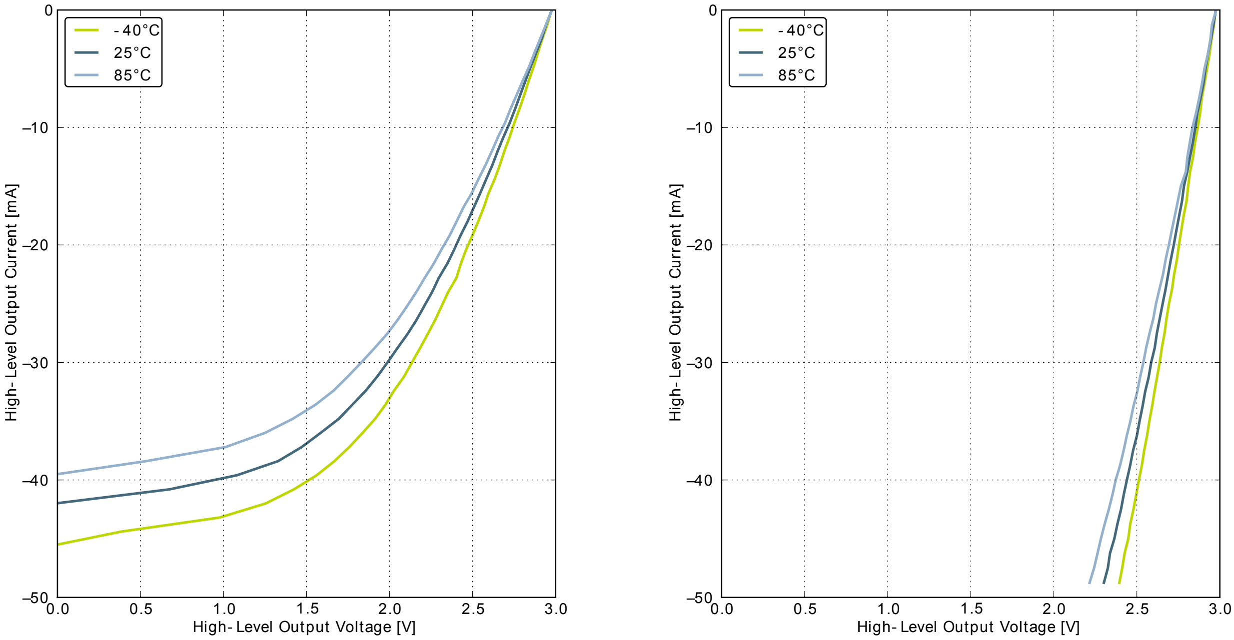
GPIO_Px_CTRL DRIVEMODE = HIGH

Figure 3.17. Typical High-Level Output Current, 3V Supply Voltage



GPIO_Px_CTRL DRIVEMODE = LOWEST

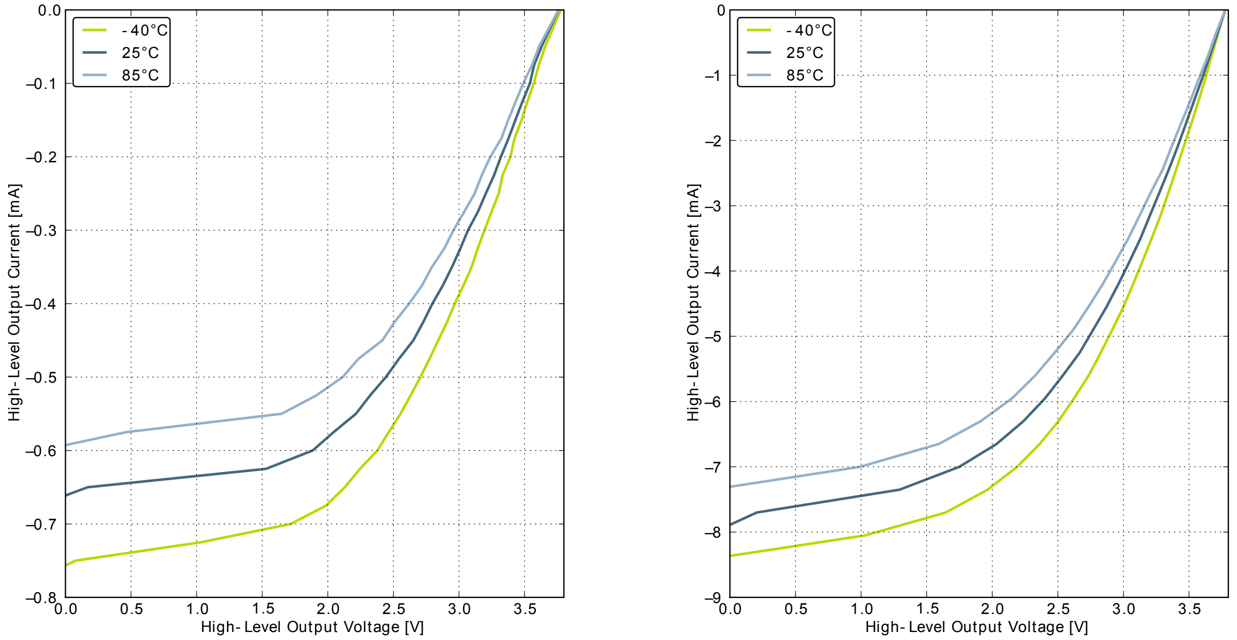
GPIO_Px_CTRL DRIVEMODE = LOW



GPIO_Px_CTRL DRIVEMODE = STANDARD

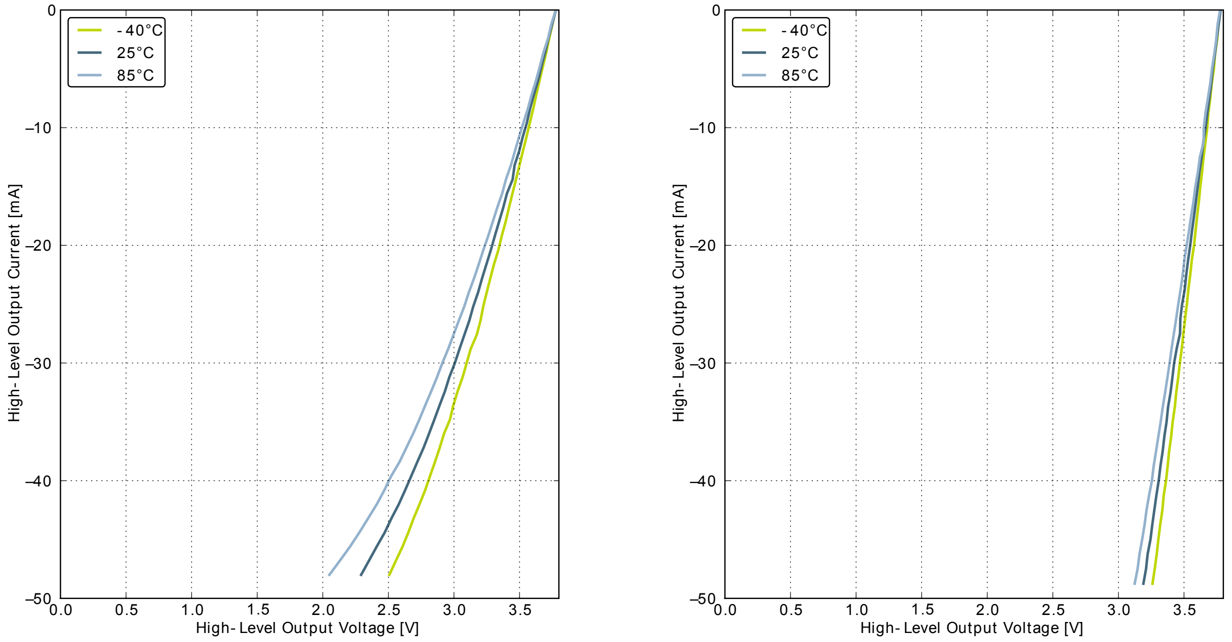
GPIO_Px_CTRL DRIVEMODE = HIGH

Figure 3.19. Typical High-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

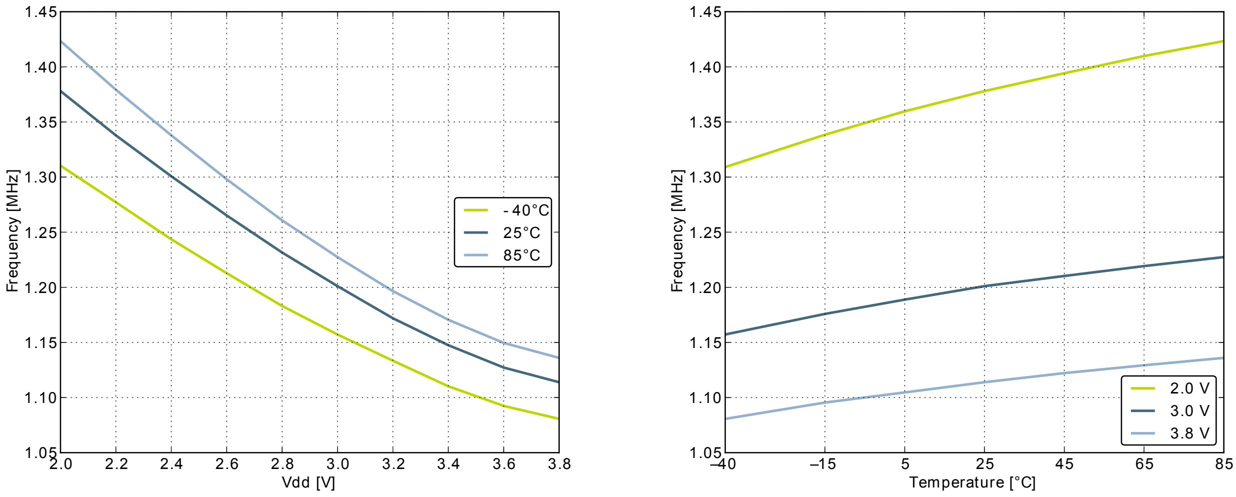
3.9.4 HFRCO

Table 3.11. HFRCO

Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{HFRCO}	Oscillation frequency, V_{DD}= 3.0 V, T_{AMB}=25°C	24 MHz frequency band	23.28	24.0	24.72	MHz
		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
$t_{HFRCO\_settling}$	Settling time after start-up	f_{HFRCO} = 14 MHz		0.6		Cycles
I_{HFRCO}	Current consumption	f_{HFRCO} = 24 MHz		158	184	µA
		f_{HFRCO} = 21 MHz		143	175	µA
		f_{HFRCO} = 14 MHz		113	140	µA
		f_{HFRCO} = 11 MHz		101	125	µA
		f_{HFRCO} = 6.6 MHz		84	105	µA
		f_{HFRCO} = 1.2 MHz		27	40	µA
$TUNESTEP_{HFRCO}$	Frequency step for LSB change in TUNING value	24 MHz frequency band		66.8[1]		kHz
		21 MHz frequency band		52.8[1]		kHz
		14 MHz frequency band		36.9[1]		kHz
		11 MHz frequency band		30.1[1]		kHz
		7 MHz frequency band		18.0[1]		kHz
		1 MHz frequency band		3.4		kHz

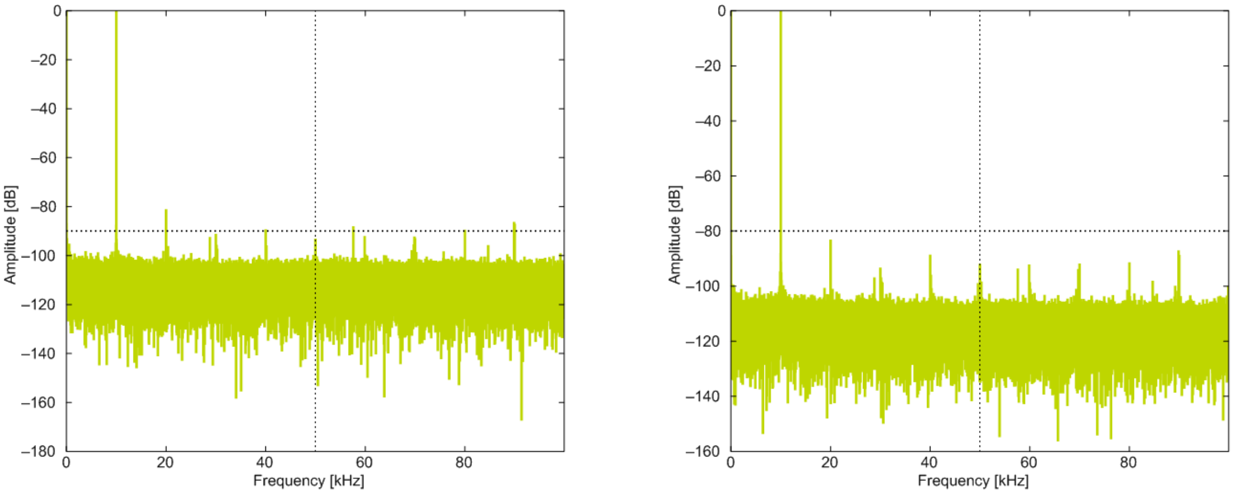
[1] The TUNING field in the CMU_HFRCOCTRL register may be used to adjust the HFRCO frequency. There is enough adjustment range to ensure that the frequency bands above 7 MHz will always have some overlap across supply voltage and temperature. By using a stable frequency reference such as the LFXO or HFXO, a firmware calibration routine can vary the TUNING bits and the frequency band to maintain the HFRCO frequency at any arbitrary value between 7 MHz and 21 MHz across operating conditions.

Figure 3.21. Calibrated HFRCO 1 MHz Band Frequency vs Supply Voltage and Temperature



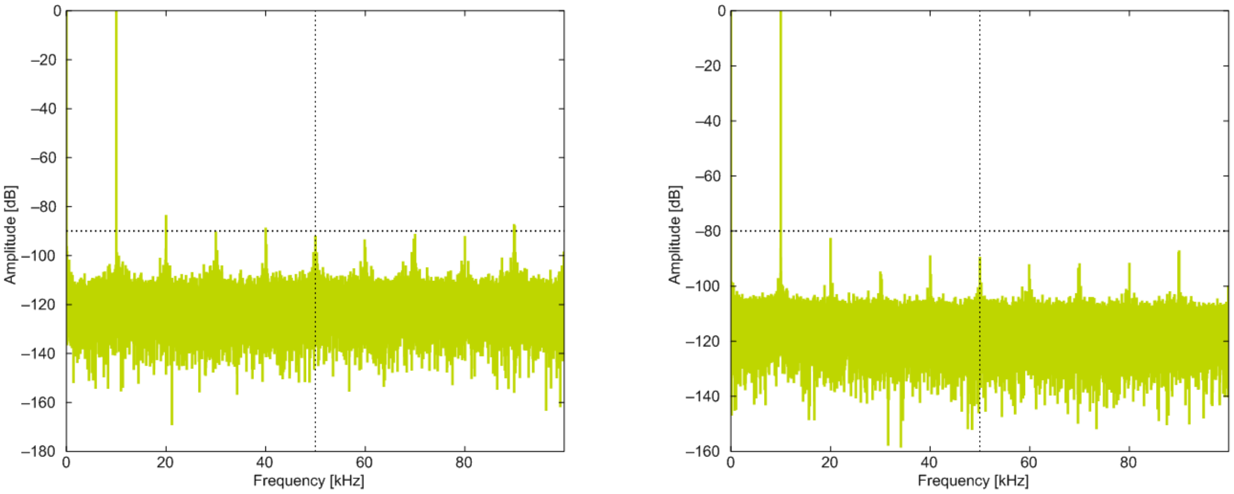
3.10.1 Typical performance

Figure 3.28. ADC Frequency Spectrum, Vdd = 3V, Temp = 25°C



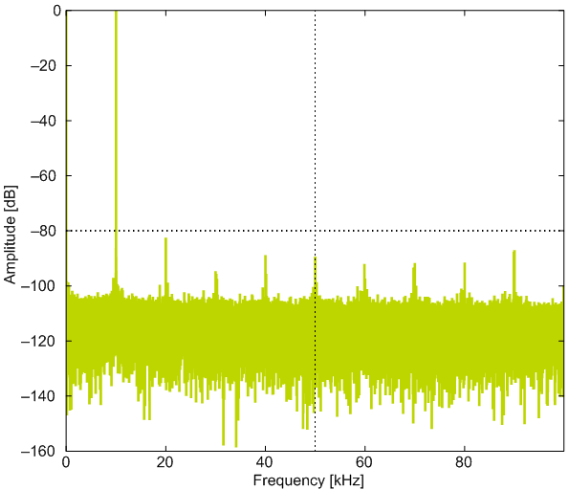
1.25V Reference

2.5V Reference



2XVDDVSS Reference

5VDIFF Reference



VDD Reference

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I_{0x10}	Nominal IDAC output current with STEPSEL=0x10			8.5		µA
I_{STEP}	Step size			0.5		µA
I_D	Current drop at high impedance load	V_{IDAC_OUT} = 200 mV		0.62		%
TC_{IDAC}	Temperature coefficient	V_{DD} = 3.0 V, STEPSEL=0x10		2.8		nA/°C
VC_{IDAC}	Voltage coefficient	T = 25 °C, STEPSEL=0x10		94.4		nA/V

Table 3.22. IDAC Range 3 Source

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I_{IDAC}	Active current with STEPSEL=0x10	EM0, default settings		18.7		µA
		Duty-cycled		10		nA
I_{0x10}	Nominal IDAC output current with STEPSEL=0x10			33.9		µA
I_{STEP}	Step size			2.0		µA
I_D	Current drop at high impedance load	V_{IDAC_OUT} = V_{DD} - 100 mV		3.54		%
TC_{IDAC}	Temperature coefficient	V_{DD} = 3.0 V, STEPSEL=0x10		10.9		nA/°C
VC_{IDAC}	Voltage coefficient	T = 25 °C, STEPSEL=0x10		159.5		nA/V

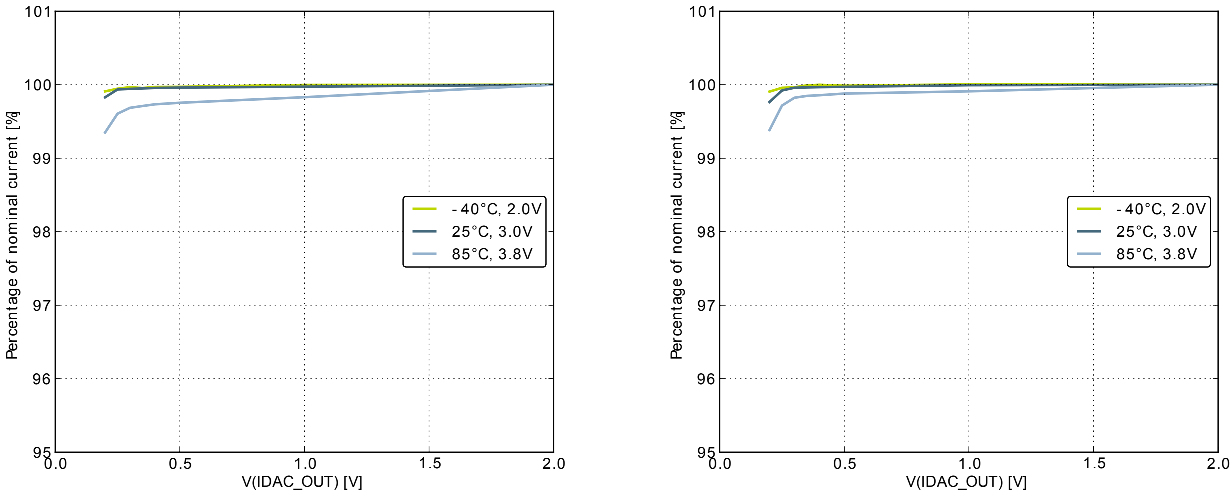
Table 3.23. IDAC Range 3 Sink

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I_{IDAC}	Active current with STEPSEL=0x10	EM0, default settings		62.5		µA
I_{0x10}	Nominal IDAC output current with STEPSEL=0x10			34.1		µA
I_{STEP}	Step size			2.0		µA
I_D	Current drop at high impedance load	V_{IDAC_OUT} = 200 mV		1.75		%
TC_{IDAC}	Temperature coefficient	V_{DD} = 3.0 V, STEPSEL=0x10		10.9		nA/°C
VC_{IDAC}	Voltage coefficient	T = 25 °C, STEPSEL=0x10		148.6		nA/V

Table 3.24. IDAC

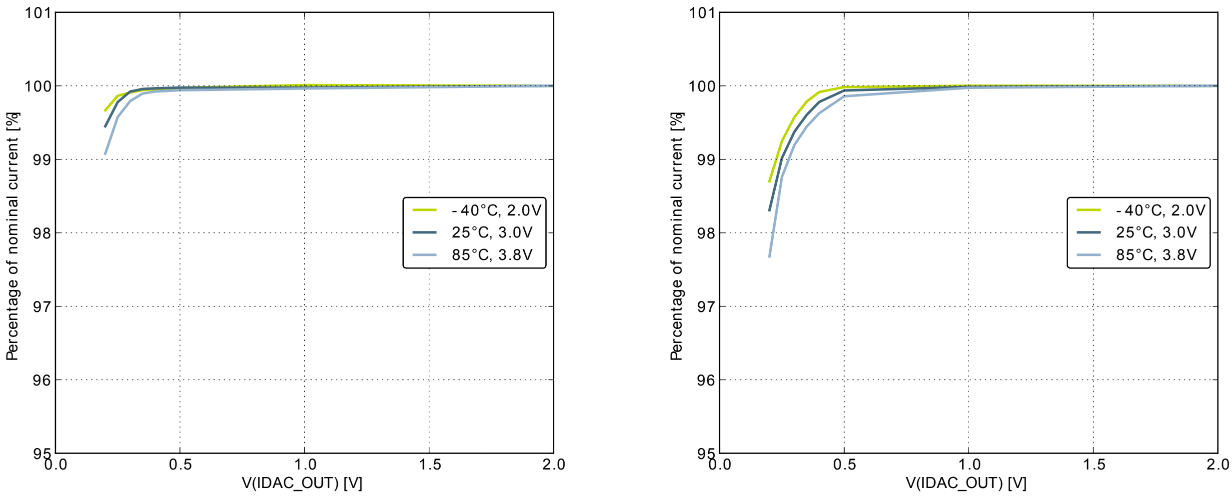
Symbol	Parameter	Min	Typ	Max	Unit
$t_{IDACSTART}$	Start-up time, from enabled to output settled		40		µs

Figure 3.35. IDAC Sink Current as a function of voltage from IDAC_OUT



Range 0

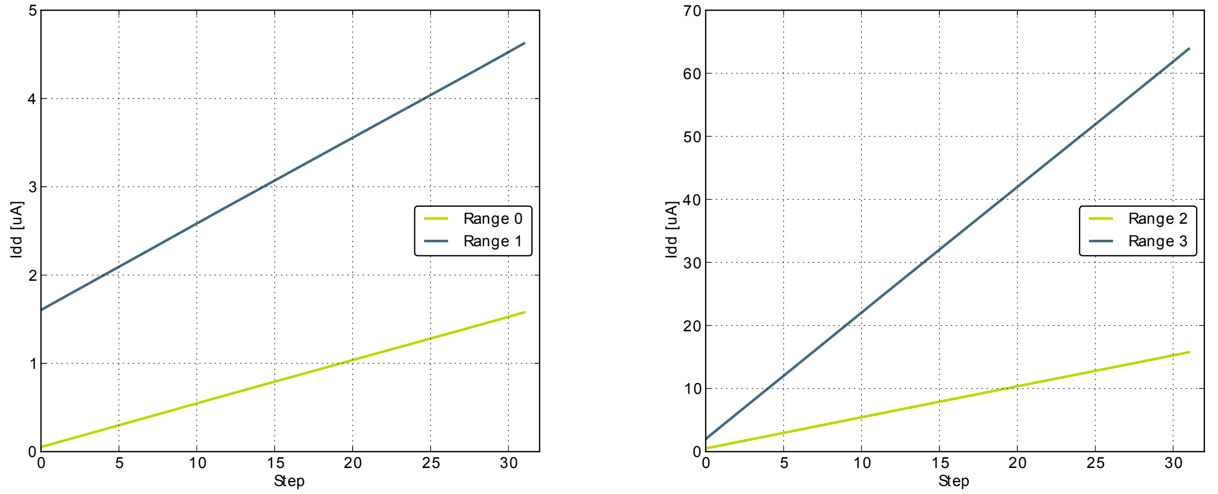
Range 1



Range 2

Range 3

Figure 3.36. IDAC linearity



3.12 Analog Comparator (ACMP)

Table 3.25. ACMP

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{ACMPIN}	Input voltage range		0		V_{DD}	V
V_{ACMPCM}	ACMP Common Mode voltage range		0		V_{DD}	V
I_{ACMP}	Active current	BIASPROG=0b0000, FULLBIAS=0 and HALFBIAS=1 in ACMPn_CTRL register		0.1	0.4	µA
		BIASPROG=0b1111, FULLBIAS=0 and HALFBIAS=0 in ACMPn_CTRL register		2.87	15	µA
		BIASPROG=0b1111, FULLBIAS=1 and HALFBIAS=0 in ACMPn_CTRL register		195	520	µA
$I_{ACMPREF}$	Current consumption of internal voltage reference	Internal voltage reference off. Using external voltage reference		0		µA
		Internal voltage reference		5		µA
$V_{ACMPOFFSET}$	Offset voltage	BIASPROG= 0b1010, FULLBIAS=0 and HALFBIAS=0 in ACMPn_CTRL register	-12	0	12	mV
$V_{ACMPHYST}$	ACMP hysteresis	Programmable		17		mV
R_{CSRES}	Capacitive Sense Internal Resistance	CSRESSEL=0b00 in ACMPn_INPUTSEL		40		kOhm
		CSRESSEL=0b01 in ACMPn_INPUTSEL		70		kOhm
		CSRESSEL=0b10 in ACMPn_INPUTSEL		101		kOhm
		CSRESSEL=0b11 in ACMPn_INPUTSEL		132		kOhm
$t_{ACMPSTART}$	Startup time				10	µs

The total ACMP current is the sum of the contributions from the ACMP and its internal voltage reference as given in Equation 3.1 (p. 47) . $I_{ACMPREF}$ is zero if an external voltage reference is used.

Total ACMP Active Current

$$I_{ACMPTOTAL} = I_{ACMP} + I_{ACMPREF} \qquad (3.1)$$

Table 3.28. I2C Fast-mode (Fm)

Symbol	Parameter	Min	Typ	Max	Unit
f_{SCL}	SCL clock frequency	0		400[1]	kHz
t_{LOW}	SCL clock low time	1.3			µs
t_{HIGH}	SCL clock high time	0.6			µs
$t_{SU,DAT}$	SDA set-up time	100			ns
$t_{HD,DAT}$	SDA hold time	8		900[2,3]	ns
$t_{SU,STA}$	Repeated START condition set-up time	0.6			µs
$t_{HD,STA}$	(Repeated) START condition hold time	0.6			µs
$t_{SU,STO}$	STOP condition set-up time	0.6			µs
t_{BUF}	Bus free time between a STOP and START condition	1.3			µs

[1] For the minimum HFPERCLK frequency required in Fast-mode, see the I2C chapter in the EFM32HG Reference Manual.

[2] The maximum SDA hold time ($t_{HD,DAT}$) needs to be met only when the device does not stretch the low time of SCL (t_{LOW}).

[3] When transmitting data, this number is guaranteed only when I2Cn_CLKDIV < $((900 \cdot 10^{-9}$ [s] $* f_{HFPERCLK}$ [Hz]) - 5).

Table 3.29. I2C Fast-mode Plus (Fm+)

Symbol	Parameter	Min	Typ	Max	Unit
f_{SCL}	SCL clock frequency	0		1000[1]	kHz
t_{LOW}	SCL clock low time	0.5			µs
t_{HIGH}	SCL clock high time	0.26			µs
$t_{SU,DAT}$	SDA set-up time	50			ns
$t_{HD,DAT}$	SDA hold time	8			ns
$t_{SU,STA}$	Repeated START condition set-up time	0.26			µs
$t_{HD,STA}$	(Repeated) START condition hold time	0.26			µs
$t_{SU,STO}$	STOP condition set-up time	0.26			µs
t_{BUF}	Bus free time between a STOP and START condition	0.5			µs

[1] For the minimum HFPERCLK frequency required in Fast-mode Plus, see the I2C chapter in the EFM32HG Reference Manual.

3.15 USB

The USB hardware in the EFM32HG322 passes all tests for USB 2.0 Full Speed certification. The test report will be distributed with application note "AN0046 - USB Hardware Design Guide" when ready.

Table 3.30. USB

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{USBOUT}	USB regulator output voltage		3.1	3.4	3.7	V
I_{USBOUT}	USB regulator output current	BIASPROG=0, T_{AMB}=25°C	55.7	79.4	104.1	mA
		BIASPROG=1, T_{AMB}=25°C	66.0	95.9	126.4	mA
		BIASPROG=2, T_{AMB}=25°C	94.6	146.5	188.1	mA
		BIASPROG=3, T_{AMB}=25°C	80.4	128.3	176.0	mA

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

4 Pinout and Package

Note

Please refer to the application note "AN0002 EFM32 Hardware Design Considerations" for guidelines on designing Printed Circuit Boards (PCB's) for the EFM32HG322.

4.1 Pinout

The *EFM32HG322* pinout is shown in Figure 4.1 (p. 52) and Table 4.1 (p. 52). Alternate locations are denoted by "#" followed by the location number (Multiple locations on the same pin are split with "/"). Alternate locations can be configured in the LOCATION bitfield in the *_ROUTE register in the module in question.

Figure 4.1. EFM32HG322 Pinout (top view, not to scale)

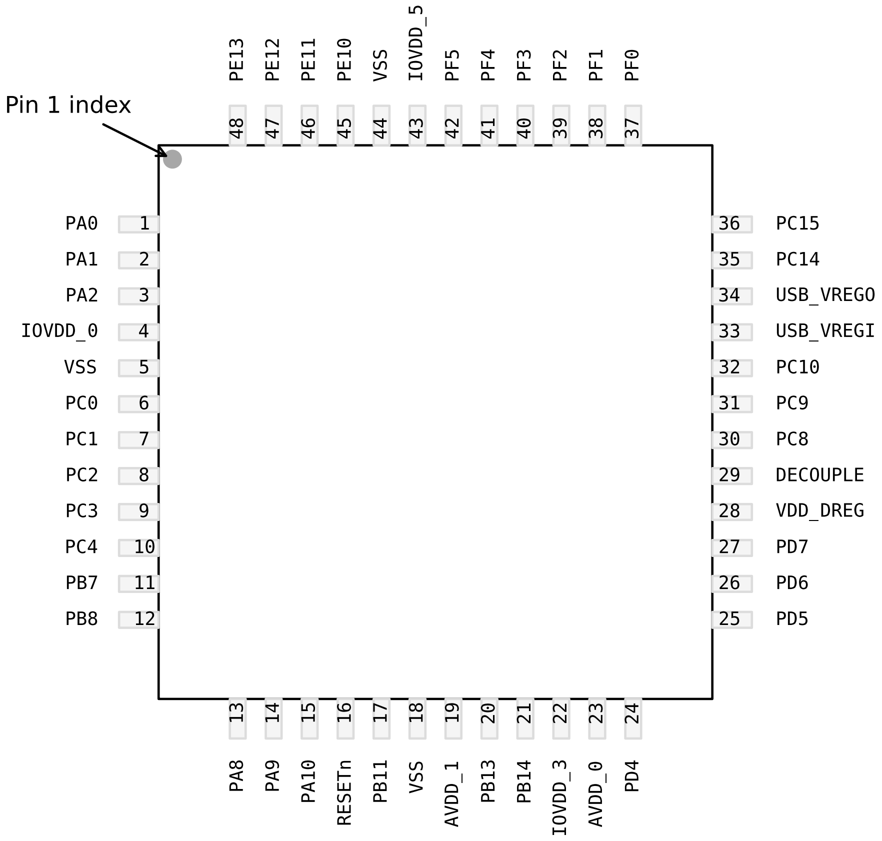


Table 4.1. Device Pinout

QFP48 Pin# and Name		Pin Alternate Functionality / Description			
Pin #	Pin Name	Analog	Timers	Communication	Other
1	PA0		TIM0_CC1 #6 TIM0_CC0 #0/1/4 PCNT0_S0IN #4	USB_DMPU #0 US1_RX #4 LEU0_RX #4 I2C0_SDA #0	PRS_CH0 #0 PRS_CH3 #3 GPIO_EM4WU0
2	PA1		TIM0_CC0 #6 TIM0_CC1 #0/1	I2C0_SCL #0	CMU_CLK1 #0 PRS_CH1 #0

QFP48 Pin# and Name		Pin Alternate Functionality / Description			
Pin #	Pin Name	Analog	Timers	Communication	Other
34	USB_VREGO				
35	PC14		TIM0_CDTI1 #1/6 TIM1_CC1 #0 PCNT0_S1IN #0	US0_CS #3 US1_CS #3/4 LEU0_TX #5 USB_DM	PRS_CH0 #2
36	PC15		TIM0_CDTI2 #1/6 TIM1_CC2 #0	US0_CLK #3 US1_CLK #3 LEU0_RX #5 USB_DP	PRS_CH1 #2
37	PF0		TIM0_CC0 #5	US1_CLK #2 LEU0_TX #3 I2C0_SDA #5	DBG_SWCLK #0 BOOT_TX
38	PF1		TIM0_CC1 #5	US1_CS #2 LEU0_RX #3 I2C0_SCL #5	DBG_SWDIO #0 GPIO_EM4WU3 BOOT_RX
39	PF2		TIM0_CC2 #5/6 TIM2_CC0 #3	US1_TX #4 LEU0_TX #4	CMU_CLK0 #3 PRS_CH0 #3 GPIO_EM4WU4
40	PF3		TIM0_CDTI0 #5		PRS_CH0 #1
41	PF4		TIM0_CDTI1 #5		PRS_CH1 #1
42	PF5		TIM0_CDTI2 #5		PRS_CH2 #1
43	IOVDD_5	Digital IO power supply 5.			
44	VSS	Ground.			
45	PE10		TIM1_CC0 #1	US0_TX #0	PRS_CH2 #2
46	PE11		TIM1_CC1 #1	US0_RX #0	PRS_CH3 #2
47	PE12	ADC0_CH0	TIM1_CC2 #1 TIM2_CC1 #3	US0_RX #3 US0_CLK #0/6 I2C0_SDA #6	CMU_CLK1 #2 PRS_CH1 #3
48	PE13	ADC0_CH1	TIM2_CC2 #3	US0_TX #3 US0_CS #0/6 I2C0_SCL #6	ACMP0_O #0 PRS_CH2 #3 GPIO_EM4WU5

4.2 Alternate Functionality Pinout

A wide selection of alternate functionality is available for multiplexing to various pins. This is shown in Table 4.2 (p. 54). The table shows the name of the alternate functionality in the first column, followed by columns showing the possible LOCATION bitfield settings.

Note

Some functionality, such as analog interfaces, do not have alternate settings or a LOCATION bitfield. In these cases, the pinout is shown in the column corresponding to LOCATION 0.

Table 4.2. Alternate functionality overview

Alternate	LOCATION							
Functionality	0	1	2	3	4	5	6	Description
ACMP0_CH0	PC0							Analog comparator ACMP0, channel 0.
ACMP0_CH1	PC1							Analog comparator ACMP0, channel 1.
ACMP0_CH2	PC2							Analog comparator ACMP0, channel 2.
ACMP0_CH3	PC3							Analog comparator ACMP0, channel 3.

9. Exact shape of each corner is optional.

Table 4.4. QFP48 (Dimensions in mm)

DIM	MIN	NOM	MAX	DIM	MIN	NOM	MAX
A	-	7.000 BSC	-	M	-	12DEG REF	-
A1	-	3.500 BSC	-	N	0.090	-	0.160
B	-	7.000 BSC	-	P	-	0.250 BSC	-
B1	-	3.500 BSC	-	R	0.150	-	0.250
C	1.000	-	1.200	S	-	9.000 BSC	-
D	0.170	-	0.270	S1	-	4.500 BSC	-
E	0.950	-	1.050	V	-	9.000 BSC	-
F	0.170	-	0.230	V1	-	4.500 BSC	-
G	-	0.500 BSC	-	W	-	0.200 BSC	-
H	0.050	-	0.150	AA	-	1.000 BSC	-
J	0.090	-	0.200				
K	0.500	-	0.700				
L	0DEG	-	7DEG				

The TQFP48 Package is 7 by 7 mm in size and has a 0.5 mm pin pitch.

The TQFP48 package uses matte-Sn post plated leadframe.

All EFM32 packages are RoHS compliant and free of Bromine (Br) and Antimony (Sb).

For additional Quality and Environmental information, please see:
http://www.silabs.com/support/quality/pages/default.aspx

Figure 5.2. TQFP48 PCB Solder Mask

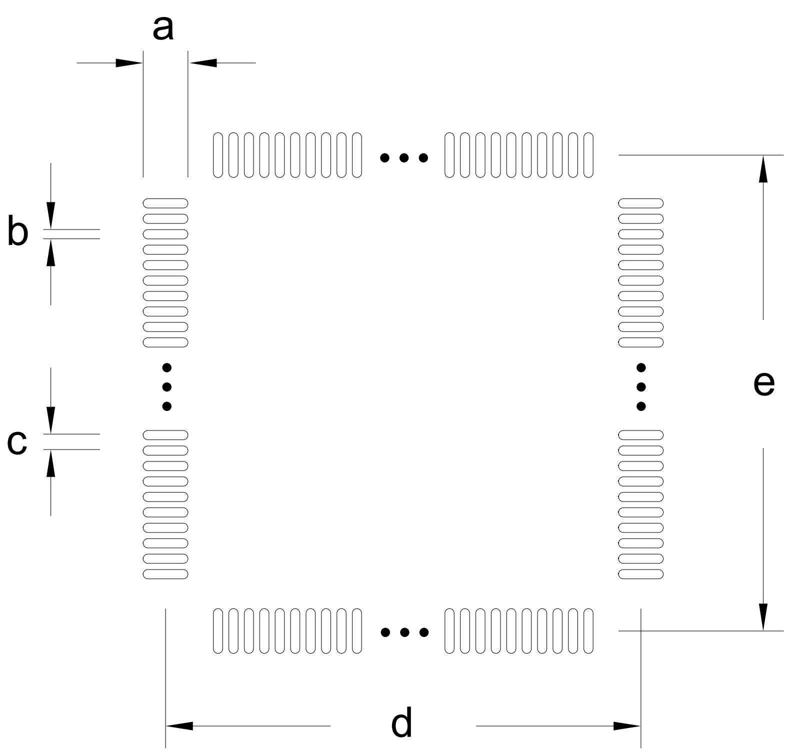


Table 5.2. QFP48 PCB Solder Mask Dimensions (Dimensions in mm)

Symbol	Dim. (mm)
a	1.72
b	0.42
c	0.50
d	8.50
e	8.50

B Contact Information

Silicon Laboratories Inc.
400 West Cesar Chavez
Austin, TX 78701

Please visit the Silicon Labs Technical Support web page:
http://www.silabs.com/support/pages/contacttechnicalsupport.aspx
and register to submit a technical support request.

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ARM Cortex-M3

LEOPARD
ARM Cortex-M3

GIANT
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WONDER
ARM Cortex-M4