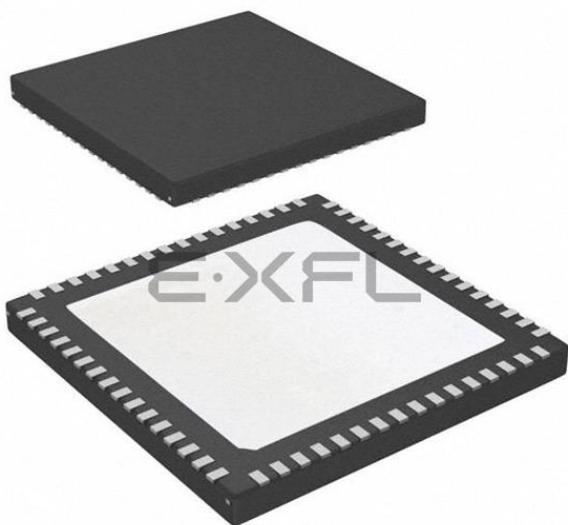




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"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable 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	Active
Core Processor	ARM® Cortex®-M3
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	I ² C, IrDA, SmartCard, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	56
Program Memory Size	1MB (1M x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	128K x 8
Voltage - Supply (Vcc/Vdd)	1.98V ~ 3.8V
Data Converters	A/D 8x12b; D/A 2x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°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/silicon-labs/efm32gg230f1024g-e-qfn64

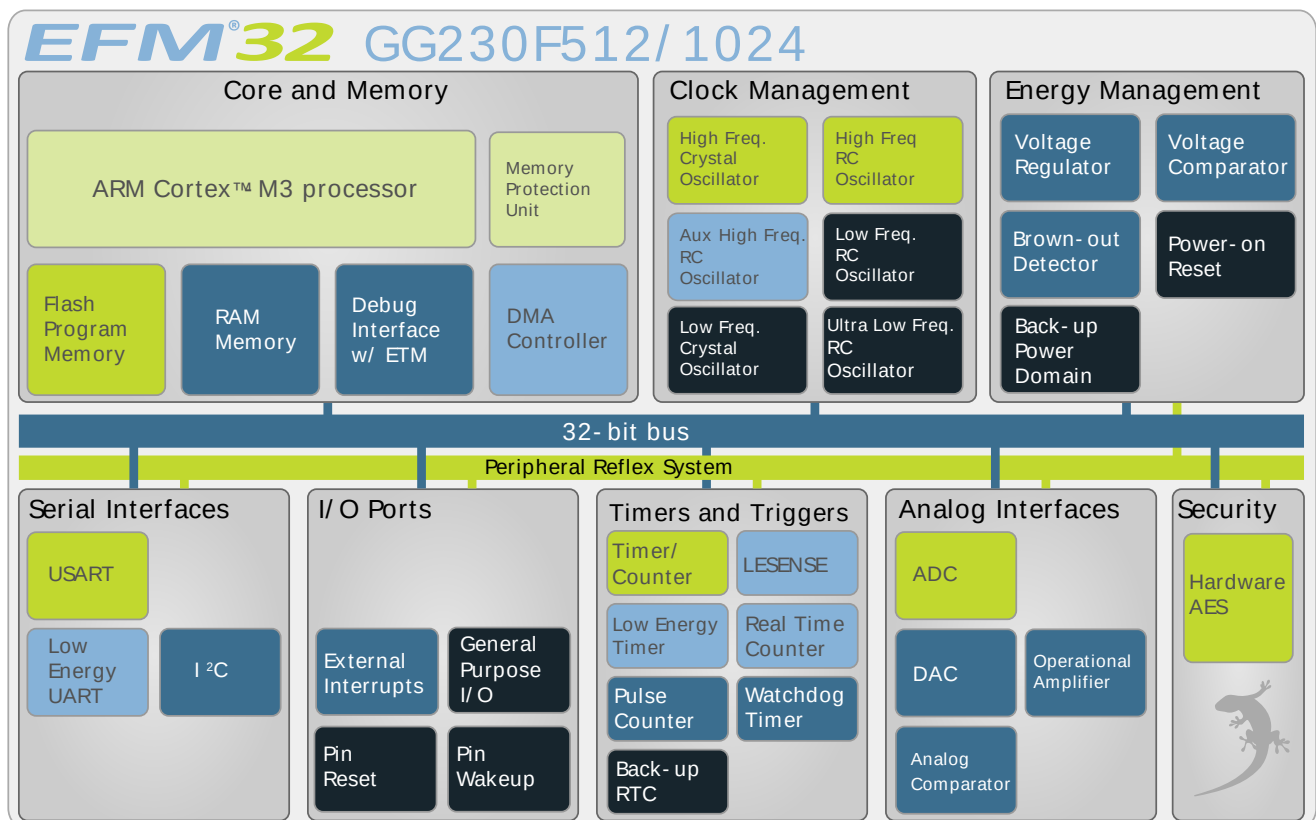
2 System Summary

2.1 System Introduction

The EFM32 MCUs are the world's most energy friendly microcontrollers. With a unique combination of the powerful 32-bit ARM Cortex-M3, innovative low energy techniques, short wake-up time from energy saving modes, and a wide selection of peripherals, the EFM32GG microcontroller is well suited for any battery operated application as well as other systems requiring high performance and low-energy consumption. This section gives a short introduction to each of the modules in general terms and also shows a summary of the configuration for the EFM32GG230 devices. For a complete feature set and in-depth information on the modules, the reader is referred to the *EFM32GG Reference Manual*.

A block diagram of the EFM32GG230 is shown in Figure 2.1 (p. 3) .

Figure 2.1. Block Diagram



2.1.1 ARM Cortex-M3 Core

The ARM Cortex-M3 includes a 32-bit RISC processor which can achieve as much as 1.25 Dhrystone MIPS/MHz. A Memory Protection Unit with support for up to 8 memory segments is included, as well as a Wake-up Interrupt Controller handling interrupts triggered while the CPU is asleep. The EFM32 implementation of the Cortex-M3 is described in detail in *EFM32 Cortex-M3 Reference Manual*.

2.1.2 Debug Interface (DBG)

This device includes hardware debug support through a 2-pin serial-wire debug interface and an Embedded Trace Module (ETM) for data/instruction tracing. In addition there is also a 1-wire Serial Wire Viewer pin which can be used to output profiling information, data trace and software-generated messages.

process and close to automatic transfers. Automatic recognition of slave addresses is provided in all energy modes.

2.1.11 Universal Synchronous/Asynchronous Receiver/Transmitter (USART)

The Universal Synchronous Asynchronous serial Receiver and Transmitter (USART) is a very flexible serial I/O module. It supports full duplex asynchronous UART communication as well as RS-485, SPI, MicroWire and 3-wire. It can also interface with ISO7816 SmartCards, IrDA and I2S devices.

2.1.12 Pre-Programmed UART Bootloader

The bootloader presented in application note AN0003 is pre-programmed in the device at factory. Auto-baud and destructive write are supported. The autobaud feature, interface and commands are described further in the application note.

2.1.13 Low Energy Universal Asynchronous Receiver/Transmitter (LEUART)

The unique LEUART[™], the Low Energy UART, is a UART that allows two-way UART communication on a strict power budget. Only a 32.768 kHz clock is needed to allow UART communication up to 9600 baud/s. The LEUART includes all necessary hardware support to make asynchronous serial communication possible with minimum of software intervention and energy consumption.

2.1.14 Timer/Counter (TIMER)

The 16-bit general purpose Timer has 3 compare/capture channels for input capture and compare/Pulse-Width Modulation (PWM) output. TIMER0 also includes a Dead-Time Insertion module suitable for motor control applications.

2.1.15 Real Time Counter (RTC)

The Real Time Counter (RTC) contains a 24-bit counter and is clocked either by a 32.768 kHz crystal oscillator, or a 32.768 kHz RC oscillator. In addition to energy modes EM0 and EM1, the RTC is also available in EM2. This makes it ideal for keeping track of time since the RTC is enabled in EM2 where most of the device is powered down.

2.1.16 Backup Real Time Counter (BURTC)

The Backup Real Time Counter (BURTC) contains a 32-bit counter and is clocked either by a 32.768 kHz crystal oscillator, a 32.768 kHz RC oscillator or a 1 kHz ULFRCO. The BURTC is available in all Energy Modes and it can also run in backup mode, making it operational even if the main power should drain out.

2.1.17 Low Energy Timer (LETIMER)

The unique LETIMER[™], the Low Energy Timer, is a 16-bit timer that is available in energy mode EM2 in addition to EM1 and EM0. Because of this, it can be used for timing and output generation when most of the device is powered down, allowing simple tasks to be performed while the power consumption of the system is kept at an absolute minimum. The LETIMER can be used to output a variety of waveforms with minimal software intervention. It is also connected to the Real Time Counter (RTC), and can be configured to start counting on compare matches from the RTC.

2.1.18 Pulse Counter (PCNT)

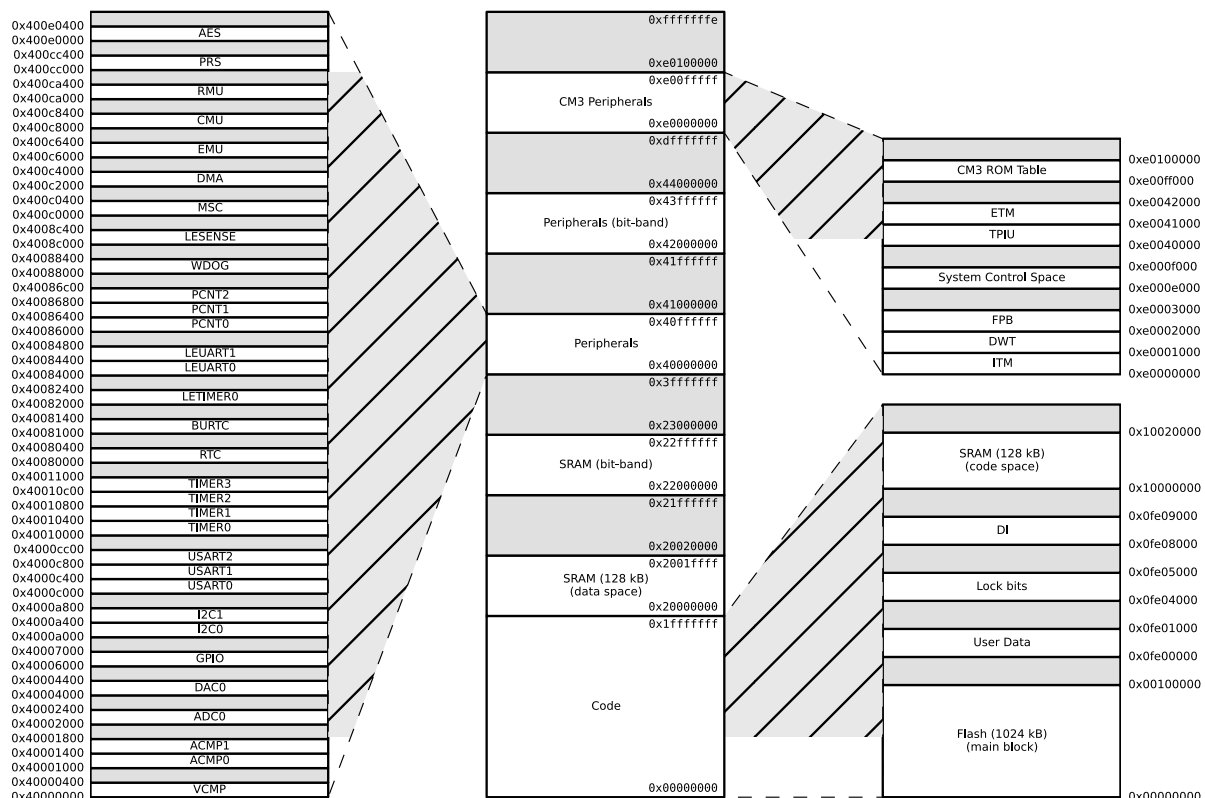
The Pulse Counter (PCNT) can be used for counting pulses on a single input or to decode quadrature encoded inputs. It runs off either the internal LFACLK or the PCNTn_S0IN pin as external clock source. The module may operate in energy mode EM0 - EM3.

Module	Configuration	Pin Connections
PCNT0	Full configuration, 16-bit count register	PCNT0_S[1:0]
PCNT1	Full configuration, 8-bit count register	PCNT1_S[1:0]
PCNT2	Full configuration, 8-bit count register	PCNT2_S[1:0]
ACMP0	Full configuration	ACMP0_CH[7:0], ACMP0_O
ACMP1	Full configuration	ACMP1_CH[7:0], ACMP1_O
VCMP	Full configuration	NA
ADC0	Full configuration	ADC0_CH[7:0]
DAC0	Full configuration	DAC0_OUT[1:0], DAC0_OUTxALT
OPAMP	Full configuration	Outputs: OPAMP_OUTx, OPAMP_OUTxALT, Inputs: OPAMP_Px, OPAMP_Nx
AES	Full configuration	NA
GPIO	56 pins	Available pins are shown in Table 4.3 (p. 55)

2.3 Memory Map

The EFM32GG230 memory map is shown in Figure 2.2 (p. 8), with RAM and Flash sizes for the largest memory configuration.

Figure 2.2. EFM32GG230 Memory Map with largest RAM and Flash sizes



3.4 Current Consumption

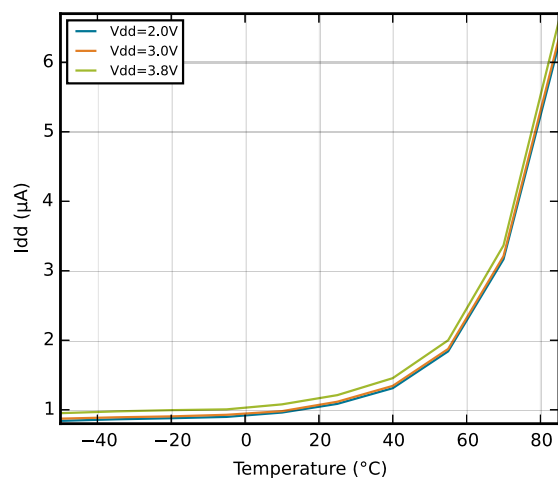
Table 3.3. Current Consumption

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I _{EM0}	EM0 current. No prescaling. Running prime number calculation code from flash. (Production test condition = 14MHz)	48 MHz HFXO, all peripheral clocks disabled, V _{DD} = 3.0 V		219	240	μA/ MHz
		28 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		205	225	μA/ MHz
		21 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		206	229	μA/ MHz
		14 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		209	232	μA/ MHz
		11 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		211	234	μA/ MHz
		6.6 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		215	242	μA/ MHz
		1.2 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		243	327	μA/ MHz
I _{EM1}	EM1 current (Production test condition = 14MHz)	48 MHz HFXO, all peripheral clocks disabled, V _{DD} = 3.0 V		80	90	μA/ MHz
		28 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		80	90	μA/ MHz
		21 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		81	91	μA/ MHz
		14 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		83	99	μA/ MHz
		11 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		85	100	μA/ MHz
		6.6 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		90	102	μA/ MHz
		1.2 MHz HFRCO, all peripheral clocks disabled, V _{DD} = 3.0 V		122	152	μA/ MHz
I _{EM2}	EM2 current	EM2 current with RTC prescaled to 1 Hz, 32.768 kHz LFRCO, V _{DD} = 3.0 V, T _{AMB} =25°C		1.1 ¹	1.9 ¹	μA
		EM2 current with RTC prescaled to 1 Hz, 32.768 kHz LFRCO, V _{DD} = 3.0 V, T _{AMB} =85°C		8.8 ¹	21.5 ¹	μA
I _{EM3}	EM3 current	V _{DD} = 3.0 V, T _{AMB} =25°C		0.8 ¹	1.5 ¹	μA
		V _{DD} = 3.0 V, T _{AMB} =85°C		8.2 ¹	20.3 ¹	μA
I _{EM4}	EM4 current	V _{DD} = 3.0 V, T _{AMB} =25°C		0.02	0.08	μA
		V _{DD} = 3.0 V, T _{AMB} =85°C		0.5	2.5	μA

¹ Only one RAM block enabled. The RAM block size is 32 kB.

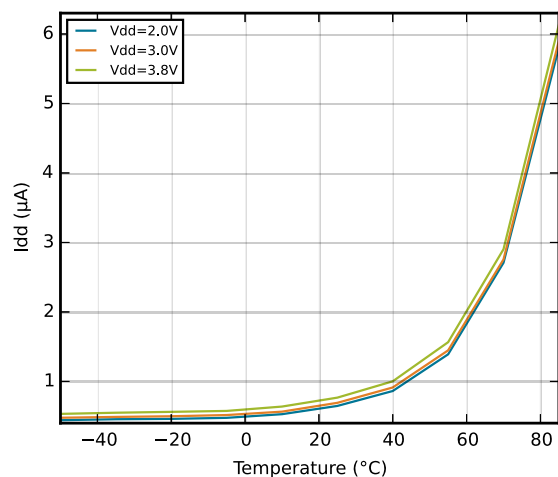
3.4.1 EM2 Current Consumption

Figure 3.1. EM2 current consumption. RTC¹ prescaled to 1 Hz, 32.768 kHz LFRCO.



3.4.2 EM3 Current Consumption

Figure 3.2. EM3 current consumption.



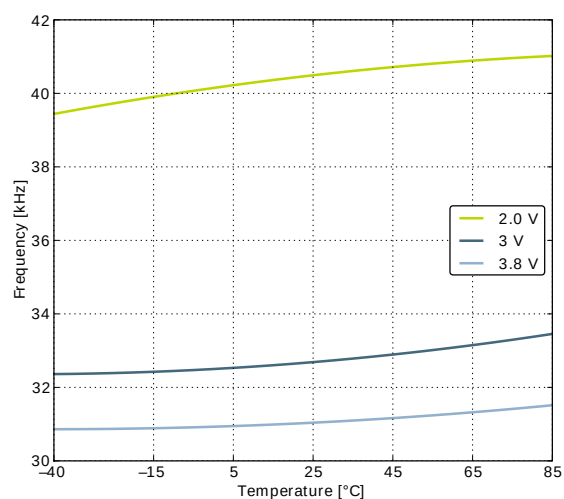
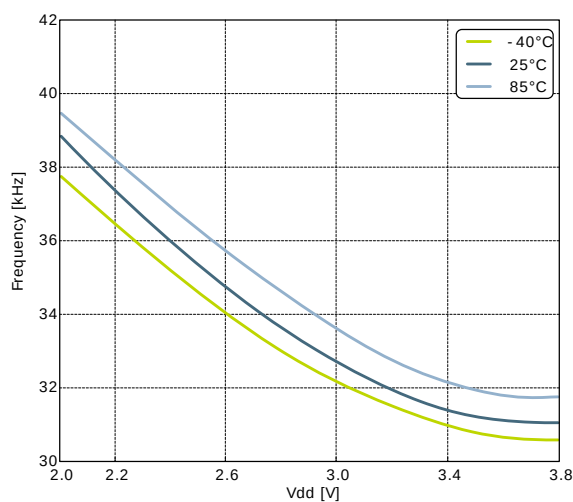
¹Using backup RTC.

3.9.3 LFRCO

Table 3.10. LFRCO

Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{LFRCO}	Oscillation frequency, $V_{\text{DD}} = 3.0 \text{ V}$, $T_{\text{AMB}} = 25^\circ\text{C}$		31.29	32.768	34.28	kHz
t_{LFRCO}	Startup time not including software calibration			150		μs
I_{LFRCO}	Current consumption			300	900	nA
$\text{TUNESTEP}_{\text{LFRCO}}$	Frequency step for LSB change in TUNING value			1.5		%

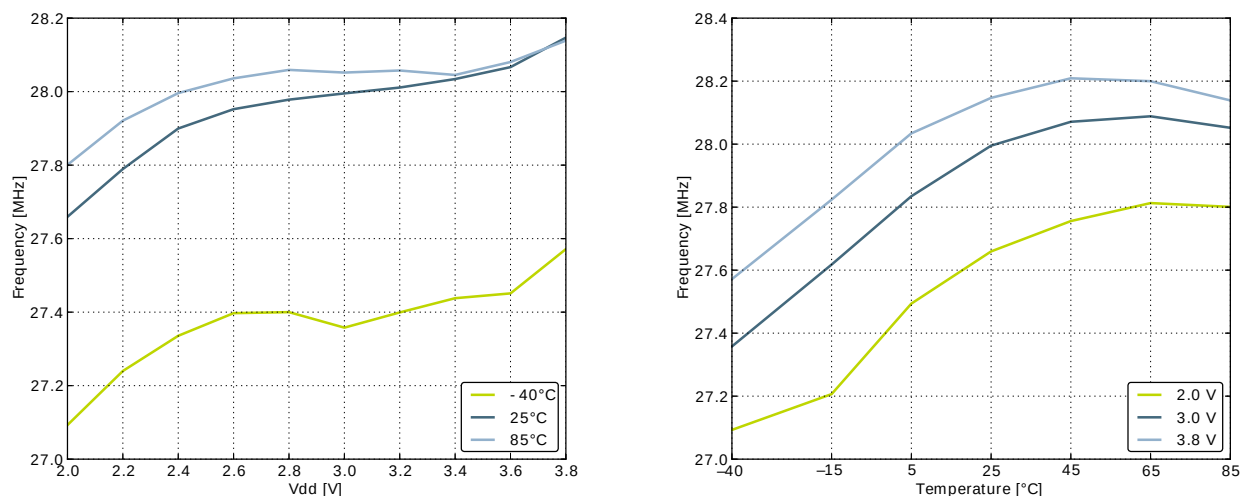
Figure 3.10. Calibrated LFRCO Frequency vs Temperature and Supply Voltage



3.9.4 HFRCO

Table 3.11. HFRCO

Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{HFRCO}	Oscillation frequency, $V_{\text{DD}} = 3.0 \text{ V}$, $T_{\text{AMB}} = 25^\circ\text{C}$	28 MHz frequency band	27.5	28.0	28.5	MHz
		21 MHz frequency band	20.6	21.0	21.4	MHz
		14 MHz frequency band	13.7	14.0	14.3	MHz
		11 MHz frequency band	10.8	11.0	11.2	MHz
		7 MHz frequency band	6.48 ¹	6.60 ¹	6.72 ¹	MHz
		1 MHz frequency band	1.15 ²	1.20 ²	1.25 ²	MHz
$t_{\text{HFRCO_settling}}$	Settling time after start-up	$f_{\text{HFRCO}} = 14 \text{ MHz}$		0.6		Cycles
	Settling time after band switch			25		Cycles

Figure 3.16. Calibrated HFRCO 28 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, $V_{\text{DD}} = 3.0 \text{ V}$, $T_{\text{AMB}} = 25^\circ\text{C}$	28 MHz frequency band	27.5	28.0	28.5	MHz
		21 MHz frequency band	20.6	21.0	21.4	MHz
		14 MHz frequency band	13.7	14.0	14.3	MHz
		11 MHz frequency band	10.8	11.0	11.2	MHz
		7 MHz frequency band	6.48 ¹	6.60 ¹	6.72 ¹	MHz
		1 MHz frequency band	1.15 ²	1.20 ²	1.25 ²	MHz
$t_{\text{AUXHFRCO_settling}}$	Settling time after start-up	$f_{\text{AUXHFRCO}} = 14 \text{ MHz}$		0.6		Cycles
$\text{DC}_{\text{AUXHFRCO}}$	Duty cycle	$f_{\text{AUXHFRCO}} = 14 \text{ MHz}$	48.5	50	51	%
$\text{TUNESTEP}_{\text{AUXHFRCO}}$	Frequency step for LSB change in TUNING value			0.3 ³		%

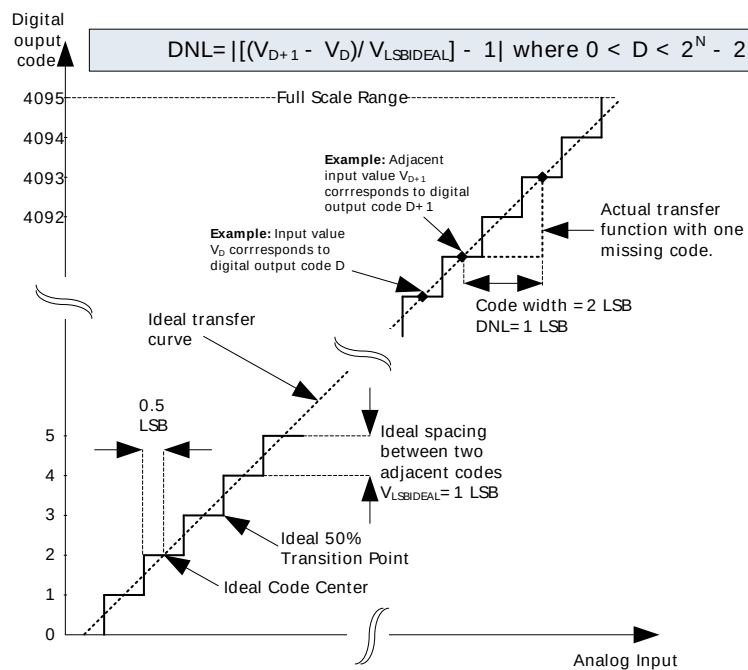
¹For devices with prod. rev. < 19, Typ = 7MHz and Min/Max values not applicable.

²For devices with prod. rev. < 19, Typ = 1MHz and Min/Max values not applicable.

³The TUNING field in the CMU_AUXHFRCOCTRL register may be used to adjust the AUXHFRCO 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 AUXHFRCO frequency at any arbitrary value between 7 MHz and 28 MHz across operating conditions.

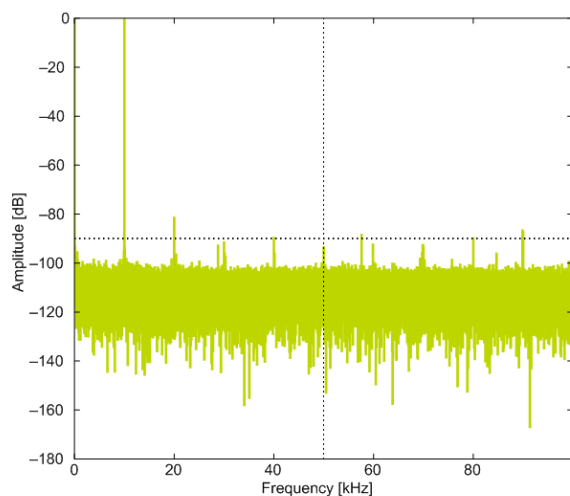
Symbol	Parameter	Condition	Min	Typ	Max	Unit
C _{ADCIN}	Input capacitance			2		pF
R _{ADCIN}	Input ON resistance		1			MOhm
R _{ADCFILT}	Input RC filter resistance			10		kOhm
C _{ADCFILT}	Input RC filter/de-coupling capacitance			250		fF
f _{ADCCLK}	ADC Clock Frequency				13	MHz
t _{ADCCONV}	Conversion time	6 bit	7			ADC-CLK Cycles
		8 bit	11			ADC-CLK Cycles
		12 bit	13			ADC-CLK Cycles
t _{ADCACQ}	Acquisition time	Programmable	1		256	ADC-CLK Cycles
t _{ADCACQVDD3}	Required acquisition time for VDD/3 reference		2			μs
t _{ADCSTART}	Startup time of reference generator and ADC core in NORMAL mode			5		μs
	Startup time of reference generator and ADC core in KEEPADCWARM mode			1		μs
SNR _{ADC}	Signal to Noise Ratio (SNR)	1 MSamples/s, 12 bit, single ended, internal 1.25V reference		59		dB
		1 MSamples/s, 12 bit, single ended, internal 2.5V reference		63		dB
		1 MSamples/s, 12 bit, single ended, V _{DD} reference		65		dB
		1 MSamples/s, 12 bit, differential, internal 1.25V reference		60		dB
		1 MSamples/s, 12 bit, differential, internal 2.5V reference		65		dB
		1 MSamples/s, 12 bit, differential, 5V reference		54		dB
		1 MSamples/s, 12 bit, differential, V _{DD} reference		67		dB
		1 MSamples/s, 12 bit, differential, 2xV _{DD} reference		69		dB

Figure 3.18. Differential Non-Linearity (DNL)

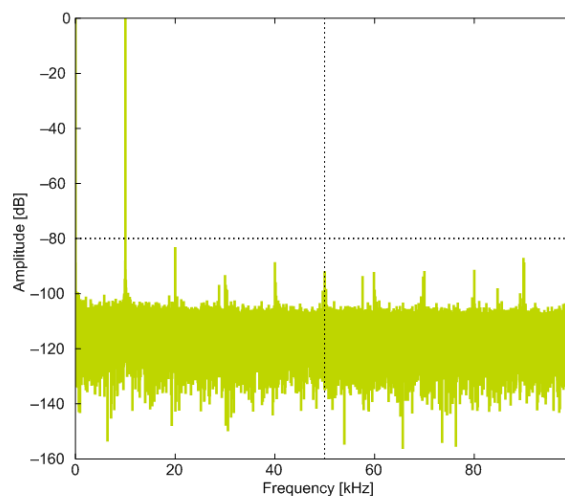


3.10.1 Typical performance

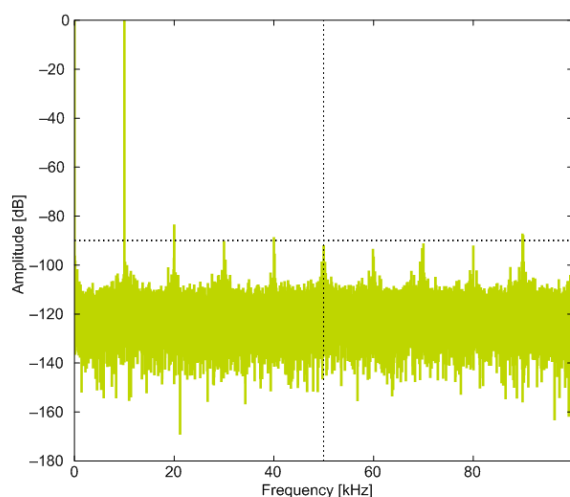
Figure 3.19. ADC Frequency Spectrum, $V_{dd} = 3V$, Temp = 25°C



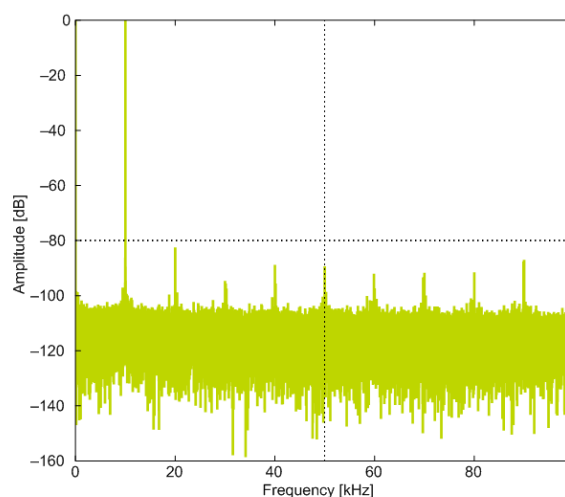
1.25V Reference



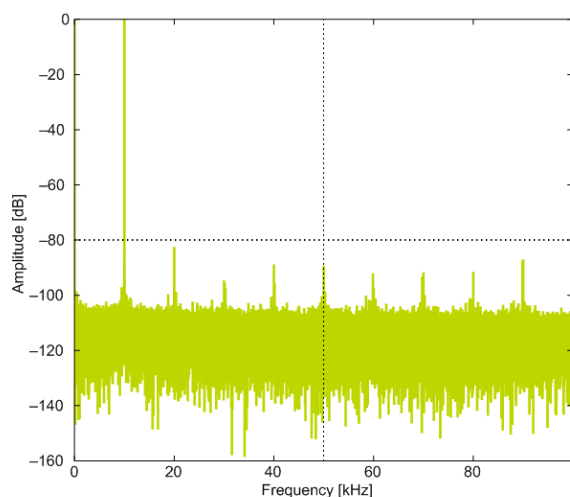
2.5V Reference



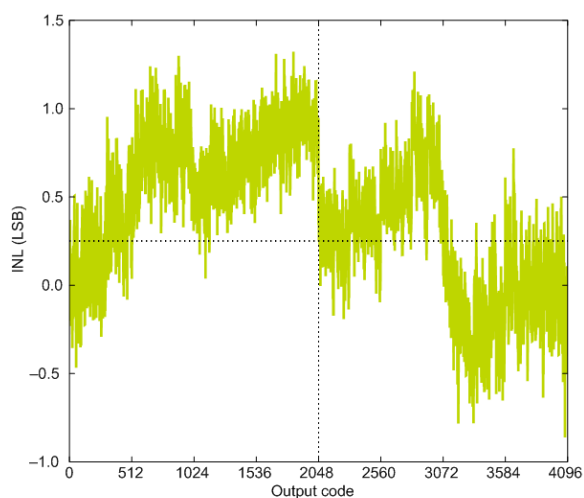
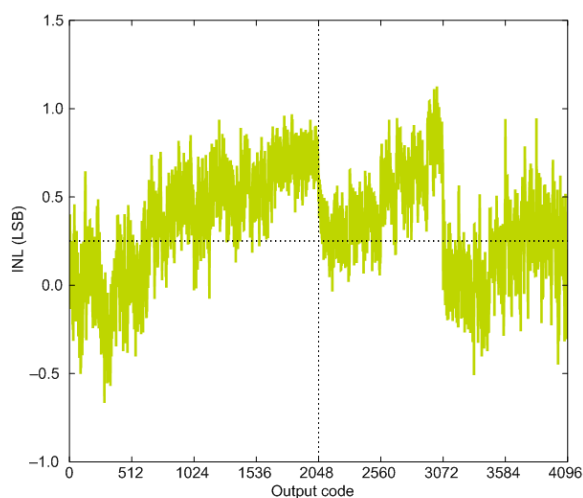
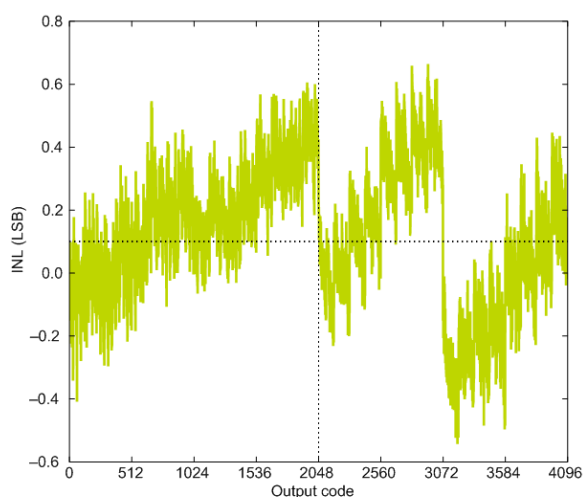
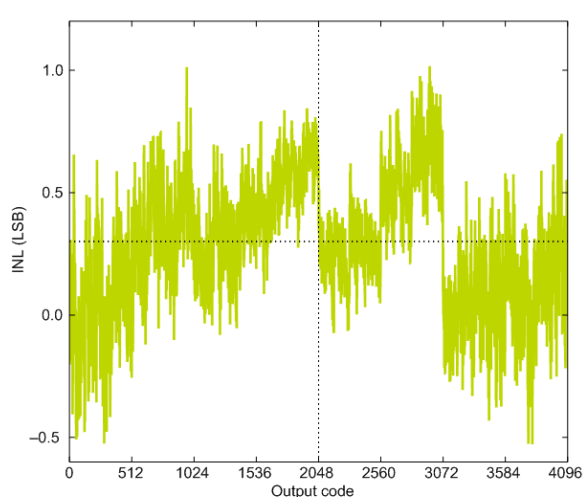
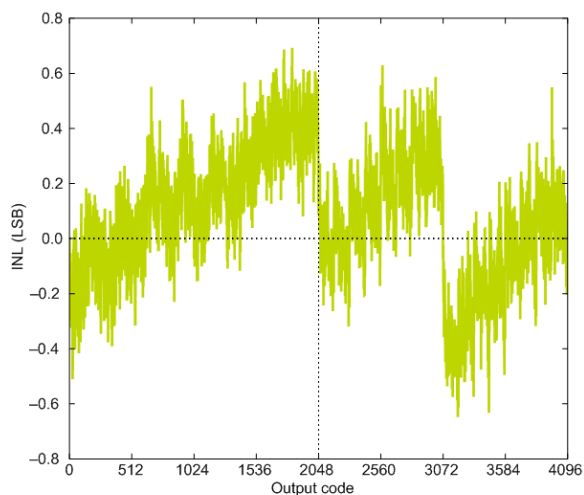
2XVDDVSS Reference



5VDIFF Reference



VDD Reference

Figure 3.20. ADC Integral Linearity Error vs Code, Vdd = 3V, Temp = 25°C**1.25V Reference****2.5V Reference****2XVDDVSS Reference****5VDIFF Reference****VDD Reference**

Symbol	Parameter	Condition	Min	Typ	Max	Unit
		500 kSamples/s, 12 bit, differential, internal 2.5V reference		58		dB
		500 kSamples/s, 12 bit, differential, V_{DD} reference		59		dB
SNDR _{DAC}	Signal to Noise-pulse Distortion Ratio (SNDR)	500 kSamples/s, 12 bit, single ended, internal 1.25V reference		57		dB
		500 kSamples/s, 12 bit, single ended, internal 2.5V reference		54		dB
		500 kSamples/s, 12 bit, differential, internal 1.25V reference		56		dB
		500 kSamples/s, 12 bit, differential, internal 2.5V reference		53		dB
		500 kSamples/s, 12 bit, differential, V_{DD} reference		55		dB
SFDR _{DAC}	Spurious-Free Dynamic Range(SFDR)	500 kSamples/s, 12 bit, single ended, internal 1.25V reference		62		dBc
		500 kSamples/s, 12 bit, single ended, internal 2.5V reference		56		dBc
		500 kSamples/s, 12 bit, differential, internal 1.25V reference		61		dBc
		500 kSamples/s, 12 bit, differential, internal 2.5V reference		55		dBc
		500 kSamples/s, 12 bit, differential, V_{DD} reference		60		dBc
V _{DACOFFSET}	Offset voltage	After calibration, single ended		2	12	mV
		After calibration, differential		2		mV
DNL _{DAC}	Differential non-linearity			±1		LSB
INL _{DAC}	Integral non-linearity			±5		LSB
MC _{DAC}	No missing codes			12		bits

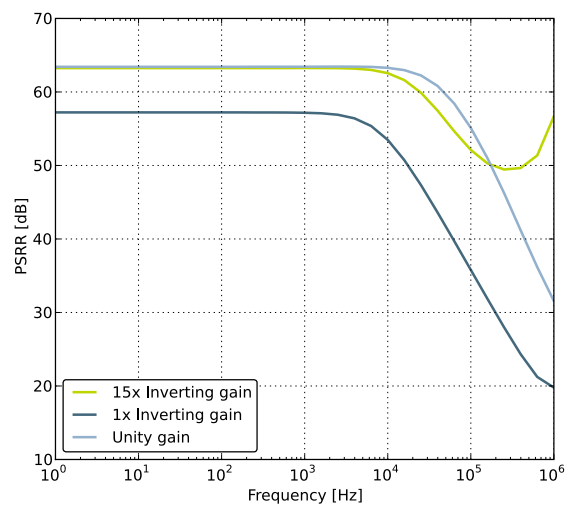
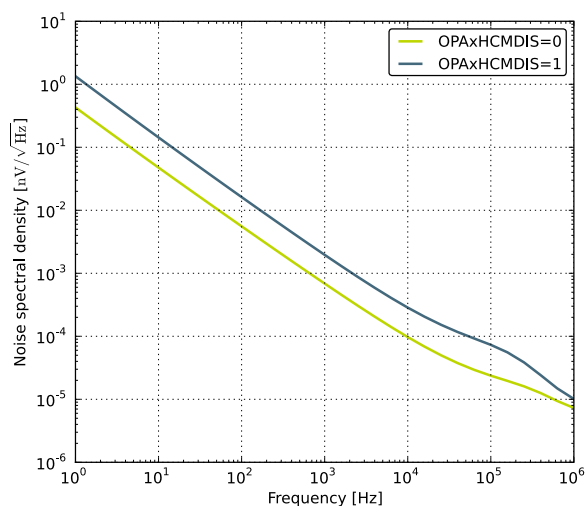
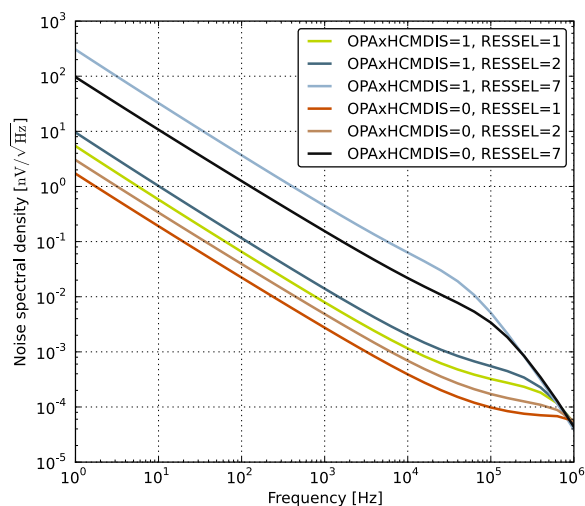
¹ Measured with a static input code and no loading on the output.

3.12 Operational Amplifier (OPAMP)

The electrical characteristics for the Operational Amplifiers are based on simulations.

Table 3.16. OPAMP

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I _{OPAMP}	Active Current	(OPA2)BIASPROG=0xF, (OPA2)HALFBIAS=0x0, Unity Gain		350	405	μA
		(OPA2)BIASPROG=0x7, (OPA2)HALFBIAS=0x1, Unity Gain		95	115	μA

Figure 3.27. OPAMP Negative Power Supply Rejection Ratio**Figure 3.28. OPAMP Voltage Noise Spectral Density (Unity Gain) $V_{out}=1V$** **Figure 3.29. OPAMP Voltage Noise Spectral Density (Non-Unity Gain)**

3.13 Analog Comparator (ACMP)

Table 3.17. 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, FULL-BIAS=0 and HALFBIAS=1 in ACMPn_CTRL register		0.1	0.6	μA
		BIASPROG=0b1111, FULL-BIAS=0 and HALFBIAS=0 in ACMPn_CTRL register		2.87	12	μA
		BIASPROG=0b1111, FULL-BIAS=1 and HALFBIAS=0 in ACMPn_CTRL register		250	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, FULL-BIAS=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		43		kOhm
		CSRESSEL=0b01 in ACMPn_INPUTSEL		78		kOhm
		CSRESSEL=0b10 in ACMPn_INPUTSEL		111		kOhm
		CSRESSEL=0b11 in ACMPn_INPUTSEL		145		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. 42) . $I_{ACMPREF}$ is zero if an external voltage reference is used.

Total ACMP Active Current

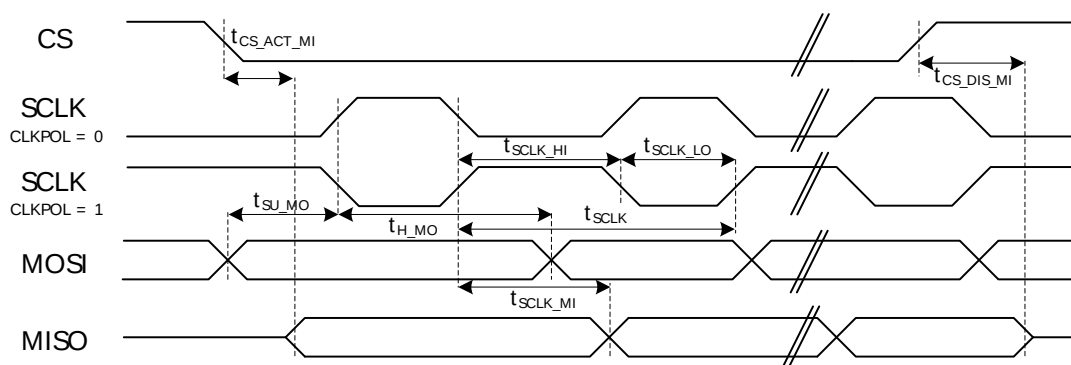
$$I_{ACMPTOTAL} = I_{ACMP} + I_{ACMPREF} \quad (3.1)$$

Table 3.22. SPI Master Timing

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$t_{\text{SCLK}}^{1,2}$	SCLK period		$2 * t_{\text{HFER-CLK}}$			ns
$t_{\text{CS_MO}}^{1,2}$	CS to MOSI		-2.00		1.00	ns
$t_{\text{SCLK_MO}}^{1,2}$	SCLK to MOSI		-4.00		3.00	ns
$t_{\text{SU_MI}}^{1,2}$	MISO setup time	IOVDD = 1.98 V	36.00			ns
		IOVDD = 3.0 V	29.00			ns
$t_{\text{H_MI}}^{1,2}$	MISO hold time		-4.00			ns

¹Applies for both CLKPHA = 0 and CLKPHA = 1 (figure only shows CLKPHA = 0)

²Measurement done at 10% and 90% of V_{DD} (figure shows 50% of V_{DD})

Figure 3.32. SPI Slave Timing**Table 3.23. SPI Slave Timing**

Symbol	Parameter	Min	Typ	Max	Unit
$t_{\text{SCLK_sl}}^{1,2}$	SCKL period	$2 * t_{\text{HFER-CLK}}$			ns
$t_{\text{SCLK_hi}}^{1,2}$	SCLK high period	$3 * t_{\text{HFER-CLK}}$			ns
$t_{\text{SCLK_lo}}^{1,2}$	SCLK low period	$3 * t_{\text{HFER-CLK}}$			ns
$t_{\text{CS_ACT_MI}}^{1,2}$	CS active to MISO	4.00		30.00	ns
$t_{\text{CS_DIS_MI}}^{1,2}$	CS disable to MISO	4.00		30.00	ns
$t_{\text{SU_MO}}^{1,2}$	MOSI setup time	4.00			ns
$t_{\text{H_MO}}^{1,2}$	MOSI hold time	$2 + 2 * t_{\text{HFER-CLK}}$			ns
$t_{\text{SCLK_MI}}^{1,2}$	SCLK to MISO	$9 + t_{\text{HFER-CLK}}$		$36 + 2 * t_{\text{HFER-CLK}}$	ns

¹Applies for both CLKPHA = 0 and CLKPHA = 1 (figure only shows CLKPHA = 0)

²Measurement done at 10% and 90% of V_{DD} (figure shows 50% of V_{DD})

QFN64 Pin# and Name		Pin Alternate Functionality / Description			
Pin #	Pin Name	Analog	Timers	Communication	Other
53	PF4		TIM0_CDTI1 #2/5		PRS_CH1 #1
54	PF5		TIM0_CDTI2 #2/5		PRS_CH2 #1
55	IOVDD_5	Digital IO power supply 5.			
56	PE8		PCNT2_S0IN #1		PRS_CH3 #1
57	PE9		PCNT2_S1IN #1		
58	PE10		TIM1_CC0 #1	US0_TX #0	BOOT_TX
59	PE11		TIM1_CC1 #1	US0_RX #0	LES_ALTEX5 #0 BOOT_RX
60	PE12		TIM1_CC2 #1	US0_RX #3 US0_CLK #0 I2C0_SDA #6	CMU_CLK1 #2 LES_ALTEX6 #0
61	PE13			US0_TX #3 US0_CS #0 I2C0_SCL #6	LES_ALTEX7 #0 ACMP0_O #0 GPIO_EM4WU5
62	PE14		TIM3_CC0 #0	LEU0_TX #2	
63	PE15		TIM3_CC1 #0	LEU0_RX #2	
64	PA15		TIM3_CC2 #0		

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. 51). 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							Description
Functionality	0	1	2	3	4	5	6	
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.
ACMP0_CH4	PC4							Analog comparator ACMP0, channel 4.
ACMP0_CH5	PC5							Analog comparator ACMP0, channel 5.
ACMP0_CH6	PC6							Analog comparator ACMP0, channel 6.
ACMP0_CH7	PC7							Analog comparator ACMP0, channel 7.
ACMP0_O	PE13		PD6					Analog comparator ACMP0, digital output.
ACMP1_CH0	PC8							Analog comparator ACMP1, channel 0.
ACMP1_CH1	PC9							Analog comparator ACMP1, channel 1.
ACMP1_CH2	PC10							Analog comparator ACMP1, channel 2.

Alternate	LOCATION							
Functionality	0	1	2	3	4	5	6	Description
US1_RX	PC1	PD1	PD6					USART1 Asynchronous Receive. USART1 Synchronous mode Master Input / Slave Output (MISO).
US1_TX	PC0	PD0	PD7					USART1 Asynchronous Transmit. Also used as receive input in half duplex communication. USART1 Synchronous mode Master Output / Slave Input (MOSI).
US2_CLK	PC4							USART2 clock input / output.
US2_CS	PC5							USART2 chip select input / output.
US2_RX	PC3							USART2 Asynchronous Receive. USART2 Synchronous mode Master Input / Slave Output (MISO).
US2_TX	PC2							USART2 Asynchronous Transmit. Also used as receive input in half duplex communication. USART2 Synchronous mode Master Output / Slave Input (MOSI).

4.3 GPIO Pinout Overview

The specific GPIO pins available in *EFM32GG230* is shown in Table 4.3 (p. 55). 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	PA15	-	-	-	-	PA10	PA9	PA8	-	PA6	PA5	PA4	PA3	PA2	PA1	PA0
Port B	-	PB14	PB13	PB12	PB11	-	-	PB8	PB7	-	-	-	-	-	-	-
Port C	PC15	PC14	PC13	PC12	PC11	PC10	PC9	PC8	PC7	PC6	PC5	PC4	PC3	PC2	PC1	PC0
Port D	-	-	-	-	-	-	-	PD8	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0
Port E	PE15	PE14	PE13	PE12	PE11	PE10	PE9	PE8	-	-	-	-	-	-	-	-
Port F	-	-	-	-	-	-	-	-	-	-	PF5	PF4	PF3	PF2	PF1	PF0

4.4 Opamp Pinout Overview

The specific opamp terminals available in *EFM32GG230* is shown in Figure 4.2 (p. 56) .

5 PCB Layout and Soldering

5.1 Recommended PCB Layout

Figure 5.1. QFN64 PCB Land Pattern

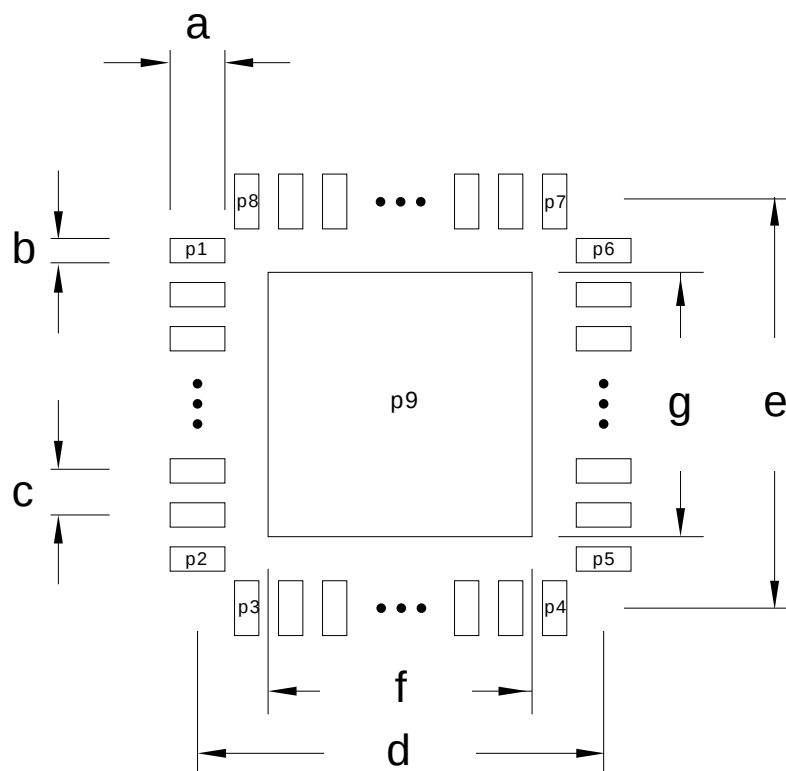


Table 5.1. QFN64 PCB Land Pattern Dimensions (Dimensions in mm)

Symbol	Dim. (mm)	Symbol	Pin number	Symbol	Pin number
a	0.85	P1	1	P8	64
b	0.30	P2	16	P9	65
c	0.50	P3	17	-	-
d	8.90	P4	32	-	-
e	8.90	P5	33	-	-
f	7.20	P6	48	-	-
g	7.20	P7	49	-	-

List of Figures

2.1. Block Diagram	3
2.2. EFM32GG230 Memory Map with largest RAM and Flash sizes	8
3.1. EM2 current consumption. RTC prescaled to 1 Hz, 32.768 kHz LFRCO.	11
3.2. EM3 current consumption.	11
3.3. EM4 current consumption.	12
3.4. Typical Low-Level Output Current, 2V Supply Voltage	16
3.5. Typical High-Level Output Current, 2V Supply Voltage	17
3.6. Typical Low-Level Output Current, 3V Supply Voltage	18
3.7. Typical High-Level Output Current, 3V Supply Voltage	19
3.8. Typical Low-Level Output Current, 3.8V Supply Voltage	20
3.9. Typical High-Level Output Current, 3.8V Supply Voltage	21
3.10. Calibrated LFRCO Frequency vs Temperature and Supply Voltage	23
3.11. Calibrated HFRCO 1 MHz Band Frequency vs Supply Voltage and Temperature	24
3.12. Calibrated HFRCO 7 MHz Band Frequency vs Supply Voltage and Temperature	24
3.13. Calibrated HFRCO 11 MHz Band Frequency vs Supply Voltage and Temperature	25
3.14. Calibrated HFRCO 14 MHz Band Frequency vs Supply Voltage and Temperature	25
3.15. Calibrated HFRCO 21 MHz Band Frequency vs Supply Voltage and Temperature	25
3.16. Calibrated HFRCO 28 MHz Band Frequency vs Supply Voltage and Temperature	26
3.17. Integral Non-Linearity (INL)	31
3.18. Differential Non-Linearity (DNL)	32
3.19. ADC Frequency Spectrum, V _{dd} = 3V, Temp = 25°C	33
3.20. ADC Integral Linearity Error vs Code, V _{dd} = 3V, Temp = 25°C	34
3.21. ADC Differential Linearity Error vs Code, V _{dd} = 3V, Temp = 25°C	35
3.22. ADC Absolute Offset, Common Mode = V _{dd} / 2	36
3.23. ADC Dynamic Performance vs Temperature for all ADC References, V _{dd} = 3V	36
3.24. ADC Temperature sensor readout	37
3.25. OPAMP Common Mode Rejection Ratio	40
3.26. OPAMP Positive Power Supply Rejection Ratio	40
3.27. OPAMP Negative Power Supply Rejection Ratio	41
3.28. OPAMP Voltage Noise Spectral Density (Unity Gain) V _{out} =1V	41
3.29. OPAMP Voltage Noise Spectral Density (Non-Unity Gain)	41
3.30. ACMP Characteristics, V _{dd} = 3V, Temp = 25°C, FULLBIAS = 0, HALFBIAS = 1	43
3.31. SPI Master Timing	45
3.32. SPI Slave Timing	46
4.1. EFM32GG230 Pinout (top view, not to scale)	48
4.2. Opamp Pinout	56
4.3. QFN64	56
5.1. QFN64 PCB Land Pattern	58
5.2. QFN64 PCB Solder Mask	59
5.3. QFN64 PCB Stencil Design	60
6.1. Example Chip Marking (top view)	61

List of Tables

1.1. Ordering Information	2
2.1. Configuration Summary	7
3.1. Absolute Maximum Ratings	9
3.2. General Operating Conditions	9
3.3. Current Consumption	10
3.4. Energy Modes Transitions	12
3.5. Power Management	13
3.6. Flash	13
3.7. GPIO	14
3.8. LFXO	22
3.9. HFXO	22
3.10. LFRCO	23
3.11. HFRCO	23
3.12. AUXHFRCO	26
3.13. ULFRCO	27
3.14. ADC	27
3.15. DAC	37
3.16. OPAMP	38
3.17. ACMP	42
3.18. VCMP	44
3.19. I2C Standard-mode (Sm)	44
3.20. I2C Fast-mode (Fm)	45
3.21. I2C Fast-mode Plus (Fm+)	45
3.22. SPI Master Timing	46
3.23. SPI Slave Timing	46
3.24. Digital Peripherals	47
4.1. Device Pinout	48
4.2. Alternate functionality overview	51
4.3. GPIO Pinout	55
4.4. QFN64 (Dimensions in mm)	57
5.1. QFN64 PCB Land Pattern Dimensions (Dimensions in mm)	58
5.2. QFN64 PCB Solder Mask Dimensions (Dimensions in mm)	59
5.3. QFN64 PCB Stencil Design Dimensions (Dimensions in mm)	60