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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 "<u>Embedded -</u> <u>Microcontrollers</u>"

Details

Product Status	Active
Core Processor	ARM® Cortex®-M4
Core Size	32-Bit Single-Core
Speed	40MHz
Connectivity	I ² C, IrDA, LINbus, SmartCard, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, I ² S, POR, PWM, WDT
Number of I/O	32
Program Memory Size	256КВ (256К х 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	32K x 8
Voltage - Supply (Vcc/Vdd)	1.85V ~ 3.8V
Data Converters	A/D 24x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-VFQFN Exposed Pad
Supplier Device Package	48-QFN (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/silicon-labs/efm32pg1b200f256gm48-c0r

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1. Feature List

The EFM32PG1 highlighted features are listed below.

ARM Cortex-M4 CPU platform

- · High performance 32-bit processor @ up to 40 MHz
- DSP instruction support and Floating Point Unit
- Memory Protection Unit
- Wake-up Interrupt Controller
- Flexible Energy Management System
 - + 63 $\mu\text{A/MHz}$ in Energy Mode 0 (EM0)
 - 2.5 μA EM2 DeepSleep current (RTCC running with state and RAM retention)
 - 0.58 µA EM4H Hibernate Mode (128 byte RAM retention)
- Up to 256 kB flash program memory
- 32 kB RAM data memory
- Up to 32 General Purpose I/O Pins
 - Configurable push-pull, open-drain, pull-up/down, input filter, drive strength
 - Configurable peripheral I/O locations
 - Asynchronous external interrupts
 - Output state retention and wake-up from Shutoff Mode

Hardware Cryptography

- AES 128/256-bit keys
- ECC B/K163, B/K233, P192, P224, P256
- SHA-1 and SHA-2 (SHA-224 and SHA-256)
- Timers/Counters
 - 2× 16-bit Timer/Counter
 - 3 + 4 Compare/Capture/PWM channels
 - 1× 32-bit Real Time Counter and Calendar
 - 1× 32-bit Ultra Low Energy CRYOTIMER for periodic wakeup from any Energy Mode
 - 16-bit Low Energy Timer for waveform generation
 - 16-bit Pulse Counter with asynchronous operation
 - Watchdog Timer with dedicated RC oscillator

- 8 Channel DMA Controller
- 12 Channel Peripheral Reflex System (PRS) for autonomous inter-peripheral signaling
- Communication Interfaces
 - 2× Universal Synchronous/Asynchronous Receiver/ Transmitter
 - UART/SPI/SmartCard (ISO 7816)/IrDA/I2S/LIN
 - Triple buffered full/half-duplex operation with flow control
 - Low Energy UART
 - Autonomous operation with DMA in Deep Sleep Mode
 - I²C Interface with SMBus support
 - Address recognition in EM3 Stop Mode
- Ultra Low-Power Precision Analog Peripherals
 - 12-bit 1 Msamples/s Analog to Digital Converter
 - 2× Analog Comparator
 - Digital to Analog Current Converter
 - Up to 32 pins connected to analog channels (APORT) shared between Analog Comparators, ADC, and IDAC
- Ultra efficient Power-on Reset and Brown-Out Detector
- Debug Interface
 - 2-pin Serial Wire Debug interface
 - 1-pin Serial Wire Viewer
 - JTAG (programming only)

Wide Operating Range

- 1.85 V to 3.8 V single power supply
- Integrated dc-dc, down to 1.8 V output with up to 200 mA load current for system
- Standard (-40 $^\circ C$ to 85 $^\circ C$ $T_{AMB})$ and Extended (-40 $^\circ C$ to 125 $^\circ C$ $T_J)$ temperature grades available
- Packages
 - 7 mm × 7 mm QFN48
 - 5 mm × 5 mm QFN32
- Pre-Programmed UART Bootloader
- Full Software Support
 - CMSIS register definitions
 - Low-power Hardware Abstraction Layer (HAL)
 - Portable software components
 - Third-party middleware
 - Free and available example code

3.2 Power

The EFM32PG1 has an Energy Management Unit (EMU) and efficient integrated regulators to generate internal supply voltages. Only a single external supply voltage is required, from which all internal voltages are created. An optional integrated dc-dc buck regulator can be utilized to further reduce the current consumption. The dc-dc regulator requires one external inductor and one external capacitor.

AVDD and VREGVDD need to be 1.85 V or higher for the MCU to operate across all conditions; however the rest of the system will operate down to 1.62 V, including the digital supply and I/O. This means that the device is fully compatible with 1.8 V components. Running from a sufficiently high supply, the device can use the dc-dc to regulate voltage not only for itself, but also for other PCB components, supplying up to a total of 200 mA.

3.2.1 Energy Management Unit (EMU)

The Energy Management Unit manages transitions of energy modes in the device. Each energy mode defines which peripherals and features are available and the amount of current the device consumes. The EMU can also be used to turn off the power to unused RAM blocks, and it contains control registers for the dc-dc regulator and the Voltage Monitor (VMON). The VMON is used to monitor multiple supply voltages. It has multiple channels which can be programmed individually by the user to determine if a sensed supply has fallen below a chosen threshold.

3.2.2 DC-DC Converter

The DC-DC buck converter covers a wide range of load currents and provides up to 90% efficiency in energy modes EM0, EM1, EM2 and EM3, and can supply up to 200 mA to the device and surrounding PCB components. Protection features include programmable current limiting, short-circuit protection, and dead-time protection. The DC-DC converter may also enter bypass mode when the input voltage is too low for efficient operation. In bypass mode, the DC-DC input supply is internally connected directly to its output through a low resistance switch. Bypass mode also supports in-rush current limiting to prevent input supply voltage droops due to excessive output current transients.

3.3 General Purpose Input/Output (GPIO)

EFM32PG1 has up to 32 General Purpose Input/Output pins. Each GPIO pin can be individually configured as either an output or input. More advanced configurations including open-drain, open-source, and glitch-filtering can be configured for each individual GPIO pin. The GPIO pins can be overridden by peripheral connections, like SPI communication. Each peripheral connection can be routed to several GPIO pins on the device. The input value of a GPIO pin can be routed through the Peripheral Reflex System to other peripherals. The GPIO subsystem supports asynchronous external pin interrupts.

3.4 Clocking

3.4.1 Clock Management Unit (CMU)

The Clock Management Unit controls oscillators and clocks in the EFM32PG1. Individual enabling and disabling of clocks to all peripheral modules is performed by the CMU. The CMU also controls enabling and configuration of the oscillators. A high degree of flexibility allows software to optimize energy consumption in any specific application by minimizing power dissipation in unused peripherals and oscillators.

3.4.2 Internal and External Oscillators

The EFM32PG1 supports two crystal oscillators and fully integrates four RC oscillators, listed below.

- A high frequency crystal oscillator (HFXO) with integrated load capacitors, tunable in small steps, provides a precise timing reference for the MCU. Crystal frequencies in the range from 38 to 40 MHz are supported. An external clock source such as a TCXO can also be applied to the HFXO input for improved accuracy over temperature.
- A 32.768 kHz crystal oscillator (LFXO) provides an accurate timing reference for low energy modes.
- An integrated high frequency RC oscillator (HFRCO) is available for the MCU system, when crystal accuracy is not required. The HFRCO employs fast startup at minimal energy consumption combined with a wide frequency range.
- An integrated auxilliary high frequency RC oscillator (AUXHFRCO) is available for timing the general-purpose ADC and the Serial Wire debug port with a wide frequency range.
- An integrated low frequency 32.768 kHz RC oscillator (LFRCO) can be used as a timing reference in low energy modes, when crystal accuracy is not required.
- An integrated ultra-low frequency 1 kHz RC oscillator (ULFRCO) is available to provide a timing reference at the lowest energy consumption in low energy modes.

3.8.4 Digital to Analog Current Converter (IDAC)

The Digital to Analog Current Converter can source or sink a configurable constant current. This current can be driven on an output pin or routed to the selected ADC input pin for capacitive sensing. The full-scale current is programmable between 0.05 μ A and 64 μ A with several ranges consisting of various step sizes.

3.9 Reset Management Unit (RMU)

The RMU is responsible for handling reset of the EFM32PG1. A wide range of reset sources are available, including several power supply monitors, pin reset, software controlled reset, core lockup reset, and watchdog reset.

3.10 Core and Memory

3.10.1 Processor Core

The ARM Cortex-M processor includes a 32-bit RISC processor integrating the following features and tasks in the system:

- ARM Cortex-M4 RISC processor achieving 1.25 Dhrystone MIPS/MHz
- · DSP instruction support and Floating Point Unit
- Memory Protection Unit (MPU) supporting up to 8 memory segments
- · Up to 256 kB flash program memory
- · Up to 32 kB RAM data memory
- · Configuration and event handling of all modules
- · 2-pin Serial-Wire debug interface

3.10.2 Memory System Controller (MSC)

The Memory System Controller (MSC) is the program memory unit of the microcontroller. The flash memory is readable and writable from both the Cortex-M and DMA. The flash memory is divided into two blocks; the main block and the information block. Program code is normally written to the main block, whereas the information block is available for special user data and flash lock bits. There is also a read-only page in the information block containing system and device calibration data. Read and write operations are supported in energy modes EM0 Active and EM1 Sleep.

3.10.3 Linked Direct Memory Access Controller (LDMA)

The Linked Direct Memory Access (LDMA) controller features 8 channels capable of performing memory operations independently of software. This reduces both energy consumption and software workload. The LDMA allows operations to be linked together and staged, enabling sophisticated operations to be implemented.

0×400f0400		1		0xfffffffe
0x400f0000	CRYPTO	` .		
0x40010000				0xe0100000
0x400e6400	PRS		CN44 Device benefic	0xe00fffff
0x400e6000			CM4 Peripherals	010000000000000000000000000000000000000
0x400e5400	RMU			Avdfffffff
0x400e5000				UXUIIIIII
0x400e4400	CMU			0×47000000
0x400e4000				0x46ffffff
0x400e3400	EMU		Peripherals (bit set)	
0x400e3000	LDMA			0x46000000
0x400e2000				0x45ffffff
0x400e1400	FPUEH			
0x400e1000				0x45000000
0x400e0800	MSC		Device even (hit elever)	0x44††††††
0x400e0000			Feripiterals (bit clear)	0×44000000
0x40052400	WDOG0			0x43ffffff
0x40052000			Peripherals (bit-band)	0,,+5111111
0x4004e400	PCNT0			0×42000000
0x4004e000				0x41ffffff
0x4004a400	LEUARTO			
0x4004a000				0×40100000
0x40046400	LETIMERO			0x400fffff
0x40046000		* / / / /	Peripherals	0
0x40042400	RTCC			0x40000000
0x40042000				0X3TTTTTTT
0x4001e400	CRYOTIMER	X / / //		0x22400000
0x4001e000				0x223fffff
0x4001c400	GPCRC		SRAM (bit-band)	
0x4001c000				0×22000000
0x40018800	TIMER1			0x21ffffff
0x40018400	TIMERO			0
0x40018000				0x20008000
0x40010800	USART1		RAMH	0X2000/TTT
0x40010400	USART0		(data space)	0x20007c00
0x40010000				0x20007bff
0x4000c400	12C0		RAMO (data space)	
0x4000c000			(data space)	0×20000000
0x4000b000	GPIO			0x1fffffff
0x4000a000				
0x40006400	IDAC0			
UX40006000			Contra	
0x40002400	ADC0	Y	Code	
0x40002000		/		
0x40000800	ACMP1	1		
0x40000400	ACMP0	V		0×00000000
UX400000000		<i>a</i>		

Figure 3.3. EFM32PG1 Memory Map — Peripherals

3.12 Configuration Summary

The features of the EFM32PG1 are a subset of the feature set described in the device reference manual. The table below describes device specific implementation of the features. Remaining modules support full configuration.

Table 3.1. Configuration Summary

Module	Configuration	Pin Connections
USART0	IrDA SmartCard	US0_TX, US0_RX, US0_CLK, US0_CS
USART1	IrDA I ² S SmartCard	US1_TX, US1_RX, US1_CLK, US1_CS
TIMER0	with DTI	TIM0_CC[2:0], TIM0_CDTI[2:0]
TIMER1		TIM1_CC[3:0]

Table 4.16. GPIO

Parameter	Symbol	Test Condition	Min	Тур	Max	Unit
Input low voltage	V _{IOIL}		—	_	IOVDD*0.3	V
Input high voltage	VIOIH		IOVDD*0.7	_	_	V
Output high voltage relative	V _{IOOH}	Sourcing 3 mA, IOVDD \ge 3 V,	IOVDD*0.8	—	—	V
		DRIVESTRENGTH ¹ = WEAK				
		Sourcing 1.2 mA, IOVDD \ge 1.62 V,	IOVDD*0.6	_	—	V
		DRIVESTRENGTH ¹ = WEAK				
		Sourcing 20 mA, IOVDD \ge 3 V,	IOVDD*0.8	_	—	V
		DRIVESTRENGTH ¹ = STRONG				
		Sourcing 8 mA, IOVDD ≥ 1.62 V,	IOVDD*0.6	_	—	V
		DRIVESTRENGTH ¹ = STRONG				
Output low voltage relative to	V _{IOOL}	Sinking 3 mA, IOVDD ≥ 3 V,	—	_	IOVDD*0.2	V
		DRIVESTRENGTH ¹ = WEAK				
		Sinking 1.2 mA, IOVDD \ge 1.62 V,	—	—	IOVDD*0.4	V
		DRIVESTRENGTH ¹ = WEAK				
		Sinking 20 mA, IOVDD ≥ 3 V,	—	_	IOVDD*0.2	V
		DRIVESTRENGTH ¹ = STRONG				
		Sinking 8 mA, IOVDD ≥ 1.62 V,	—		IOVDD*0.4	V
		DRIVESTRENGTH ¹ = STRONG				
Input leakage current	IIOLEAK	All GPIO except LFXO pins, GPIO ≤ IOVDD, T _{amb} ≤ 85 °C	_	0.1	30	nA
		LFXO Pins, GPIO ≤ IOVDD, T _{amb} ≤ 85 °C		0.1	50	nA
		All GPIO except LFXO pins, GPIO ≤ IOVDD, T _{AMB} > 85 °C	_		110	nA
		LFXO Pins, GPIO ≤ IOVDD, T _{AMB} > 85 °C	_	_	250	nA
Input leakage current on 5VTOL pads above IOVDD	I _{5VTOLLEAK}	IOVDD < GPIO ≤ IOVDD + 2 V	_	3.3	15	μA
I/O pin pull-up resistor	R _{PU}		30	43	65	kΩ
I/O pin pull-down resistor	R _{PD}		30	43	65	kΩ
Pulse width of pulses re- moved by the glitch suppres- sion filter	t _{IOGLITCH}		20	25	35	ns

Table 4.19. IDAC

Parameter	Symbol	Test Condition	Min	Тур	Max	Unit
Number of Ranges	N _{IDAC_RANGES}		_	4	_	-
Output Current	IIDAC_OUT	RANGSEL ¹ = RANGE0	0.05		1.6	μA
		RANGSEL ¹ = RANGE1	1.6		4.7	μA
		RANGSEL ¹ = RANGE2	0.5	_	16	μA
		RANGSEL ¹ = RANGE3	2	—	64	μA
Linear steps within each range	N _{IDAC_STEPS}		_	32		
Step size	SSIDAC	RANGSEL ¹ = RANGE0	_	50	_	nA
		RANGSEL ¹ = RANGE1	_	100	_	nA
		RANGSEL ¹ = RANGE2	_	500	_	nA
		RANGSEL ¹ = RANGE3	_	2	_	μA
Total Accuracy, STEPSEL ¹ = 0x10	ACCIDAC	EM0 or EM1, AVDD=3.3 V, T = 25 °C	-2		2	%
		EM0 or EM1	-18	—	22	%
		EM2 or EM3, Source mode, RANGSEL ¹ = RANGE0, AVDD=3.3 V, T = 25 °C	_	-2	_	%
		EM2 or EM3, Source mode, RANGSEL ¹ = RANGE1, AVDD=3.3 V, T = 25 °C	_	-1.7	_	%
		EM2 or EM3, Source mode, RANGSEL ¹ = RANGE2, AVDD=3.3 V, T = 25 °C	_	-0.8	_	%
		EM2 or EM3, Source mode, RANGSEL ¹ = RANGE3, AVDD=3.3 V, T = 25 °C	—	-0.5	_	%
		EM2 or EM3, Sink mode, RANG- SEL ¹ = RANGE0, AVDD=3.3 V, T = 25 °C	_	-0.7	_	%
		EM2 or EM3, Sink mode, RANG- SEL ¹ = RANGE1, AVDD=3.3 V, T = 25 °C	_	-0.6	_	%
		EM2 or EM3, Sink mode, RANG- SEL ¹ = RANGE2, AVDD=3.3 V, T = 25 °C	_	-0.5	_	%
		EM2 or EM3, Sink mode, RANG- SEL ¹ = RANGE3, AVDD=3.3 V, T = 25 °C	_	-0.5	_	%
Start up time	t _{IDAC_SU}	Output within 1% of steady state value	_	5	_	μs

4.1.16 USART SPI

SPI Master Timing

Table 4.24.	SPI	Master	Timing
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Parameter	Symbol	Test Condition	Min	Тур	Max	Unit	
SCLK period ^{1 2}	t _{SCLK}		2 * t _{HFPERCLK}	_	_	ns	
CS to MOSI ^{1 2}	t _{CS_MO}		0		8	ns	
SCLK to MOSI ^{1 2}	t _{SCLK_MO}		3		20	ns	
MISO setup time ^{1 2}	t _{su_мі}	IOVDD = 1.62 V	56	_	_	ns	
		IOVDD = 3.0 V	37	_	_	ns	
MISO hold time ^{1 2}	t _{H_MI}		6			ns	
Note:							

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

2. Measurement done with 8 pF output loading at 10% and 90% of V_{DD} (figure shows 50% of $V_{\text{DD}})$



Figure 4.1. SPI Master Timing Diagram



Figure 4.18. LFRCO Typical Performance at 32.768 kHz



Figure 4.19. ULFRCO Typical Performance at 1 kHz

6. Pin Definitions

6.1 EFM32PG1 QFN48 with DC-DC Definition



Figure 6.1. EFM32PG1 QFN48 with DC-DC Pinout

QFN	48 Pin# and Name	Pin Alternate Functionality / Description			
Pin #	Pin Name	Analog	Timers	Communication	Other
0	RFVSS	Radio Ground			I
1	PF0	BUSAX BUSBY	TIM0_CC0 #24 TIM0_CC1 #23 TIM0_CC2 #22 TIM0_CDTI0 #21 TIM0_CDTI1 #20 TIM0_CDTI2 #19 TIM1_CC0 #24 TIM1_CC1 #23 TIM1_CC2 #22 TIM1_CC3 #21 LE- TIM0_OUT0 #24 LE- TIM0_OUT1 #23 PCNT0_S0IN #24 PCNT0_S1IN #23	US0_TX #24 US0_RX #23 US0_CLK #22 US0_CS #21 US0_CTS #20 US0_RTS #19 US1_TX #24 US1_RX #23 US1_CLK #22 US1_CS #21 US1_CTS #20 US1_RTS #19 LEU0_TX #24 LEU0_RX #23 I2C0_SDA #24 I2C0_SCL #23	PRS_CH0 #0 PRS_CH1 #7 PRS_CH2 #6 PRS_CH3 #5 ACMP0_O #24 ACMP1_O #24 DBG_SWCLKTCK #0 BOOT_TX
2	PF1	BUSAY BUSBX	TIM0_CC0 #25 TIM0_CC1 #24 TIM0_CC2 #23 TIM0_CDTI0 #22 TIM0_CDTI1 #21 TIM0_CDTI2 #20 TIM1_CC0 #25 TIM1_CC1 #24 TIM1_CC2 #23 TIM1_CC3 #22 LE- TIM0_OUT0 #25 LE- TIM0_OUT1 #24 PCNT0_S0IN #25 PCNT0_S1IN #24	US0_TX #25 US0_RX #24 US0_CLK #23 US0_CS #22 US0_CTS #21 US0_RTS #20 US1_TX #25 US1_RX #24 US1_CLK #23 US1_CS #22 US1_CTS #21 US1_RTS #20 LEU0_TX #25 LEU0_RX #24 I2C0_SDA #25 I2C0_SCL #24	PRS_CH0 #1 PRS_CH1 #0 PRS_CH2 #7 PRS_CH3 #6 ACMP0_O #25 ACMP1_O #25 DBG_SWDIOTMS #0 BOOT_RX
3	PF2	BUSAX BUSBY	TIM0_CC0 #26 TIM0_CC1 #25 TIM0_CC2 #24 TIM0_CDTI0 #23 TIM0_CDTI1 #22 TIM0_CDTI2 #21 TIM1_CC0 #26 TIM1_CC1 #25 TIM1_CC2 #24 TIM1_CC3 #23 LE- TIM0_OUT0 #26 LE- TIM0_OUT1 #25 PCNT0_S0IN #26 PCNT0_S1IN #25	US0_TX #26 US0_RX #25 US0_CLK #24 US0_CS #23 US0_CTS #22 US0_RTS #21 US1_TX #26 US1_RX #25 US1_CLK #24 US1_CS #23 US1_CTS #22 US1_RTS #21 LEU0_TX #26 LEU0_RX #25 I2C0_SDA #26 I2C0_SCL #25	CMU_CLK0 #6 PRS_CH0 #2 PRS_CH1 #1 PRS_CH2 #0 PRS_CH3 #7 ACMP0_O #26 ACMP1_O #26 DBG_TDO #0 DBG_SWO #0 GPIO_EM4WU0

Table 6.1. QFN48 with DC-DC Device Pinout

QFN	48 Pin# and Name	Pin Alternate Functionality / Description			
Pin #	Pin Name	Analog	Timers	Communication	Other
28	PA3	BUSCY BUSDX	TIM0_CC0 #3 TIM0_CC1 #2 TIM0_CC2 #1 TIM0_CDTI0 #0 TIM0_CDTI1 #31 TIM0_CDTI2 #30 TIM1_CC0 #3 TIM1_CC1 #2 TIM1_CC2 #1 TIM1_CC3 #0 LE- TIM0_OUT0 #3 LE- TIM0_OUT0 #3 LE- TIM0_OUT1 #2 PCNT0_S0IN #3 PCNT0_S1IN #2	US0_TX #3 US0_RX #2 US0_CLK #1 US0_CS #0 US0_CTS #31 US0_RTS #30 US1_TX #3 US1_RX #2 US1_CLK #1 US1_CS #0 US1_CTS #31 US1_RTS #30 LEU0_TX #3 LEU0_RX #2 I2C0_SDA #3 I2C0_SCL #2	PRS_CH6 #3 PRS_CH7 #2 PRS_CH8 #1 PRS_CH9 #0 ACMP0_O #3 ACMP1_O #3 GPIO_EM4WU8
29	PA4	BUSCX BUSDY	TIM0_CC0 #4 TIM0_CC1 #3 TIM0_CC2 #2 TIM0_CDTI0 #1 TIM0_CDTI1 #0 TIM0_CDTI2 #31 TIM1_CC0 #4 TIM1_CC1 #3 TIM1_CC2 #2 TIM1_CC3 #1 LE- TIM0_OUT0 #4 LE- TIM0_OUT1 #3 PCNT0_S0IN #4 PCNT0_S1IN #3	US0_TX #4 US0_RX #3 US0_CLK #2 US0_CS #1 US0_CTS #0 US0_RTS #31 US1_TX #4 US1_RX #3 US1_CLK #2 US1_CS #1 US1_CTS #0 US1_RTS #31 LEU0_TX #4 LEU0_RX #3 I2C0_SDA #4 I2C0_SCL #3	PRS_CH6 #4 PRS_CH7 #3 PRS_CH8 #2 PRS_CH9 #1 ACMP0_O #4 ACMP1_O #4
30	PA5	BUSCY BUSDX	TIM0_CC0 #5 TIM0_CC1 #4 TIM0_CC2 #3 TIM0_CDTI0 #2 TIM0_CDTI1 #1 TIM0_CDTI2 #0 TIM1_CC0 #5 TIM1_CC1 #4 TIM1_CC2 #3 TIM1_CC3 #2 LE- TIM0_OUT0 #5 LE- TIM0_OUT0 #5 LE- TIM0_OUT1 #4 PCNT0_S0IN #5 PCNT0_S1IN #4	US0_TX #5 US0_RX #4 US0_CLK #3 US0_CS #2 US0_CTS #1 US0_RTS #0 US1_TX #5 US1_RX #4 US1_CLK #3 US1_CS #2 US1_CTS #1 US1_RTS #0 LEU0_TX #5 LEU0_RX #4 I2C0_SDA #5 I2C0_SCL #4	PRS_CH6 #5 PRS_CH7 #4 PRS_CH8 #3 PRS_CH9 #2 ACMP0_O #5 ACMP1_O #5
31	PB11	BUSCY BUSDX	TIM0_CC0 #6 TIM0_CC1 #5 TIM0_CC2 #4 TIM0_CDTI0 #3 TIM0_CDTI1 #2 TIM0_CDTI2 #1 TIM1_CC0 #6 TIM1_CC1 #5 TIM1_CC3 #3 LE- TIM1_CC3 #3 LE- TIM0_OUT0 #6 LE- TIM0_OUT1 #5 PCNT0_S0IN #6 PCNT0_S1IN #5	US0_TX #6 US0_RX #5 US0_CLK #4 US0_CS #3 US0_CTS #2 US0_RTS #1 US1_TX #6 US1_RX #5 US1_CLK #4 US1_CS #3 US1_CTS #2 US1_RTS #1 LEU0_TX #6 LEU0_RX #5 I2C0_SDA #6 I2C0_SCL #5	PRS_CH6 #6 PRS_CH7 #5 PRS_CH8 #4 PRS_CH9 #3 ACMP0_O #6 ACMP1_O #6

QFN	32 Pin# and Name	Pin Alternate Functionality / Description			
Pin #	Pin Name	Analog	Timers	Communication	Other
11	PD10	BUSCX BUSDY	TIM0_CC0 #18 TIM0_CC1 #17 TIM0_CC2 #16 TIM0_CDTI0 #15 TIM0_CDT11 #14 TIM0_CDT12 #13 TIM1_CC0 #18 TIM1_CC1 #17 TIM1_CC2 #16 TIM1_CC3 #15 LE- TIM0_OUT0 #18 LE- TIM0_OUT0 #18 LE- TIM0_OUT1 #17 PCNT0_S0IN #18 PCNT0_S1IN #17	US0_TX #18 US0_RX #17 US0_CLK #16 US0_CS #15 US0_CTS #14 US0_RTS #13 US1_TX #18 US1_RX #17 US1_CLK #16 US1_CS #15 US1_CTS #14 US1_RTS #13 LEU0_TX #18 LEU0_RX #17 I2C0_SDA #18 I2C0_SCL #17	CMU_CLK1 #4 PRS_CH3 #9 PRS_CH4 #1 PRS_CH5 #0 PRS_CH6 #12 ACMP0_O #18 ACMP1_O #18
12	PD11	BUSCY BUSDX	TIM0_CC0 #19 TIM0_CC1 #18 TIM0_CC2 #17 TIM0_CDTI0 #16 TIM0_CDT11 #15 TIM0_CDT12 #14 TIM1_CC0 #19 TIM1_CC1 #18 TIM1_CC2 #17 TIM1_CC3 #16 LE- TIM0_OUT0 #19 LE- TIM0_OUT1 #18 PCNT0_S0IN #19 PCNT0_S1IN #18	US0_TX #19 US0_RX #18 US0_CLK #17 US0_CS #16 US0_CTS #15 US0_RTS #14 US1_TX #19 US1_RX #18 US1_CLK #17 US1_CS #16 US1_CTS #15 US1_RTS #14 LEU0_TX #19 LEU0_RX #18 I2C0_SDA #19 I2C0_SCL #18	PRS_CH3 #10 PRS_CH4 #2 PRS_CH5 #1 PRS_CH6 #13 ACMP0_O #19 ACMP1_O #19
13	PD12	BUSCX BUSDY	TIM0_CC0 #20 TIM0_CC1 #19 TIM0_CC2 #18 TIM0_CDTI0 #17 TIM0_CDT11 #16 TIM0_CDT12 #15 TIM1_CC0 #20 TIM1_CC1 #19 TIM1_CC2 #18 TIM1_CC3 #17 LE- TIM0_OUT0 #20 LE- TIM0_OUT1 #19 PCNT0_S0IN #20 PCNT0_S1IN #19	US0_TX #20 US0_RX #19 US0_CLK #18 US0_CS #17 US0_CTS #16 US0_RTS #15 US1_TX #20 US1_RX #19 US1_CLK #18 US1_CS #17 US1_CTS #16 US1_RTS #15 LEU0_TX #20 LEU0_RX #19 I2C0_SDA #20 I2C0_SCL #19	PRS_CH3 #11 PRS_CH4 #3 PRS_CH5 #2 PRS_CH6 #14 ACMP0_O #20 ACMP1_O #20
14	PD13	BUSCY BUSDX	TIM0_CC0 #21 TIM0_CC1 #20 TIM0_CC2 #19 TIM0_CDTI0 #18 TIM0_CDT11 #17 TIM0_CDT12 #16 TIM1_CC0 #21 TIM1_CC1 #20 TIM1_CC2 #19 TIM1_CC3 #18 LE- TIM0_OUT0 #21 LE- TIM0_OUT0 #21 LE- TIM0_OUT1 #20 PCNT0_S0IN #21 PCNT0_S1IN #20	US0_TX #21 US0_RX #20 US0_CLK #19 US0_CS #18 US0_CTS #17 US0_RTS #16 US1_TX #21 US1_RX #20 US1_CLK #19 US1_CS #18 US1_CTS #17 US1_RTS #16 LEU0_TX #21 LEU0_RX #20 I2C0_SDA #21 I2C0_SCL #20	PRS_CH3 #12 PRS_CH4 #4 PRS_CH5 #3 PRS_CH6 #15 ACMP0_O #21 ACMP1_O #21

QFN32 Pin# and Name Pin Alternate Functionality / Description					
Pin #	Pin Name	Analog	Timers	Communication	Other
19	PB11	BUSCY BUSDX	TIM0_CC0 #6 TIM0_CC1 #5 TIM0_CC2 #4 TIM0_CDTI0 #3 TIM0_CDTI1 #2 TIM0_CDTI2 #1 TIM1_CC0 #6 TIM1_CC1 #5 TIM1_CC2 #4 TIM1_CC3 #3 LE- TIM0_OUT0 #6 LE- TIM0_OUT0 #6 LE- TIM0_OUT1 #5 PCNT0_S0IN #6 PCNT0_S1IN #5	US0_TX #6 US0_RX #5 US0_CLK #4 US0_CS #3 US0_CTS #2 US0_RTS #1 US1_TX #6 US1_RX #5 US1_CLK #4 US1_CS #3 US1_CTS #2 US1_RTS #1 LEU0_TX #6 LEU0_RX #5 I2C0_SDA #6 I2C0_SCL #5	PRS_CH6 #6 PRS_CH7 #5 PRS_CH8 #4 PRS_CH9 #3 ACMP0_O #6 ACMP1_O #6
20	PB12	BUSCX BUSDY	TIM0_CC0 #7 TIM0_CC1 #6 TIM0_CC2 #5 TIM0_CDTI0 #4 TIM0_CDTI1 #3 TIM0_CDT12 #2 TIM1_CC0 #7 TIM1_CC1 #6 TIM1_CC2 #5 TIM1_CC3 #4 LE- TIM0_OUT0 #7 LE- TIM0_OUT1 #6 PCNT0_S0IN #7 PCNT0_S1IN #6	US0_TX #7 US0_RX #6 US0_CLK #5 US0_CS #4 US0_CTS #3 US0_RTS #2 US1_TX #7 US1_RX #6 US1_CLK #5 US1_CS #4 US1_CTS #3 US1_RTS #2 LEU0_TX #7 LEU0_RX #6 I2C0_SDA #7 I2C0_SCL #6	PRS_CH6 #7 PRS_CH7 #6 PRS_CH8 #5 PRS_CH9 #4 ACMP0_O #7 ACMP1_O #7
21	PB13	BUSCY BUSDX	TIM0_CC0 #8 TIM0_CC1 #7 TIM0_CC2 #6 TIM0_CDTI0 #5 TIM0_CDTI1 #4 TIM0_CDTI2 #3 TIM1_CC0 #8 TIM1_CC1 #7 TIM1_CC2 #6 TIM1_CC3 #5 LE- TIM0_OUT0 #8 LE- TIM0_OUT0 #8 LE- TIM0_OUT1 #7 PCNT0_S0IN #8 PCNT0_S1IN #7	US0_TX #8 US0_RX #7 US0_CLK #6 US0_CS #5 US0_CTS #4 US0_RTS #3 US1_TX #8 US1_RX #7 US1_CLK #6 US1_CS #5 US1_CTS #4 US1_RTS #3 LEU0_TX #8 LEU0_RX #7 I2C0_SDA #8 I2C0_SCL #7	PRS_CH6 #8 PRS_CH7 #7 PRS_CH8 #6 PRS_CH9 #5 ACMP0_O #8 ACMP1_O #8 DBG_SWO #1 GPIO_EM4WU9
22	AVDD_0	Analog power supply 0.			
23	PB14	LFXTAL_N BUSCX BUSDY	TIM0_CC0 #9 TIM0_CC1 #8 TIM0_CC2 #7 TIM0_CDTI0 #6 TIM0_CDTI1 #5 TIM0_CDTI2 #4 TIM1_CC0 #9 TIM1_CC1 #8 TIM1_CC2 #7 TIM1_CC3 #6 LE- TIM0_OUT0 #9 LE- TIM0_OUT0 #9 LE- TIM0_OUT1 #8 PCNT0_S0IN #9 PCNT0_S1IN #8	US0_TX #9 US0_RX #8 US0_CLK #7 US0_CS #6 US0_CTS #5 US0_RTS #4 US1_TX #9 US1_RX #8 US1_CLK #7 US1_CS #6 US1_CTS #5 US1_RTS #4 LEU0_TX #9 LEU0_RX #8 I2C0_SDA #9 I2C0_SCL #8	CMU_CLK1 #1 PRS_CH6 #9 PRS_CH7 #8 PRS_CH8 #7 PRS_CH9 #6 ACMP0_O #9 ACMP1_O #9

QFN	32 Pin# and Name	Pin Alternate Functionality / Description			
Pin #	Pin Name	Analog	Timers	Communication	Other
30	PC9	BUSAY BUSBX	TIM0_CC0 #14 TIM0_CC1 #13 TIM0_CC2 #12 TIM0_CDTI0 #11 TIM0_CDTI1 #10 TIM0_CDTI2 #9 TIM1_CC0 #14 TIM1_CC1 #13 TIM1_CC2 #12 TIM1_CC3 #11 LE- TIM0_OUT0 #14 LE- TIM0_OUT1 #13 PCNT0_S0IN #14 PCNT0_S1IN #13	US0_TX #14 US0_RX #13 US0_CLK #12 US0_CS #11 US0_CTS #10 US0_RTS #9 US1_TX #14 US1_RX #13 US1_CLK #12 US1_CS #11 US1_CTS #10 US1_RTS #9 LEU0_TX #14 LEU0_RX #13 I2C0_SDA #14 I2C0_SCL #13	PRS_CH0 #11 PRS_CH9 #14 PRS_CH10 #3 PRS_CH11 #2 ACMP0_O #14 ACMP1_O #14
31	PC10	BUSAX BUSBY	TIM0_CC0 #15 TIM0_CC1 #14 TIM0_CC2 #13 TIM0_CDTI0 #12 TIM0_CDTI1 #11 TIM0_CDT12 #10 TIM1_CC0 #15 TIM1_CC1 #14 TIM1_CC2 #13 TIM1_CC3 #12 LE- TIM0_OUT0 #15 LE- TIM0_OUT1 #14 PCNT0_S0IN #15 PCNT0_S1IN #14	US0_TX #15 US0_RX #14 US0_CLK #13 US0_CS #12 US0_CTS #11 US0_RTS #10 US1_TX #15 US1_RX #14 US1_CLK #13 US1_CS #12 US1_CTS #11 US1_RTS #10 LEU0_TX #15 LEU0_RX #14 I2C0_SDA #15 I2C0_SCL #14	CMU_CLK1 #3 PRS_CH0 #12 PRS_CH9 #15 PRS_CH10 #4 PRS_CH11 #3 ACMP0_O #15 ACMP1_O #15 GPIO_EM4WU12
32	PC11	BUSAY BUSBX	TIM0_CC0 #16 TIM0_CC1 #15 TIM0_CC2 #14 TIM0_CDTI0 #13 TIM0_CDT11 #12 TIM0_CDT12 #11 TIM1_CC0 #16 TIM1_CC1 #15 TIM1_CC2 #14 TIM1_CC3 #13 LE- TIM0_OUT0 #16 LE- TIM0_OUT0 #16 LE- TIM0_OUT1 #15 PCNT0_S0IN #16 PCNT0_S1IN #15	US0_TX #16 US0_RX #15 US0_CLK #14 US0_CS #13 US0_CTS #12 US0_RTS #11 US1_TX #16 US1_RX #15 US1_CLK #14 US1_CS #13 US1_CTS #12 US1_RTS #11 LEU0_TX #16 LEU0_RX #15 I2C0_SDA #16 I2C0_SCL #15	CMU_CLK0 #3 PRS_CH0 #13 PRS_CH9 #16 PRS_CH10 #5 PRS_CH11 #4 ACMP0_O #16 ACMP1_O #16 DBG_SWO #3

6.2.1 EFM32PG1 QFN32 without DC-DC GPIO Overview

The GPIO pins are organized as 16-bit ports indicated by letters (A, B, C...), and the individual pins on each port are indicated by a number from 15 down to 0.

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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PA1	PA0
Port B	PB15	PB14	PB13 (5V)	PB12 (5V)	PB11 (5V)	-	-	-	-	-	-	-	-	-	-	-
Port C	-	-	-	-	PC11 (5V)	PC10 (5V)	PC9 (5V)	PC8 (5V)	PC7 (5V)	-	-	-	-	-	-	-
Port D	PD15 (5V)	PD14 (5V)	PD13 (5V)	PD12 (5V)	PD11 (5V)	PD10 (5V)	PD9 (5V)	-	-	-	-	-	-	-	-	-
Port F	-	-	-	-	-	-	-	-	-	-	-	PF4 (5V)	PF3 (5V)	PF2 (5V)	PF1 (5V)	PF0 (5V)

Table 6.4. QFN32 without DC-DC GPIO Pinout

Note:

1. GPIO with 5V tolerance are indicated by (5V).

2. The pins PB13, PB12, PB11, PD15, PD14, and PD13 will not be 5V tolerant on all future devices. In order to preserve upgrade options with full hardware compatibility, do not use these pins with 5V domains.

QFN	32 Pin# and Name	Pin Alternate Functionality / Description										
Pin #	Pin Name	Analog	Timers	Communication	Other							
16	PD15	BUSCY BUSDX	TIM0_CC0 #23 TIM0_CC1 #22 TIM0_CC2 #21 TIM0_CDTI0 #20 TIM0_CDTI1 #19 TIM0_CDTI2 #18 TIM1_CC0 #23 TIM1_CC1 #22 TIM1_CC2 #21 TIM1_CC3 #20 LE- TIM0_OUT0 #23 LE- TIM0_OUT1 #22 PCNT0_S0IN #23 PCNT0_S1IN #22	US0_TX #23 US0_RX #22 US0_CLK #21 US0_CS #20 US0_CTS #19 US0_RTS #18 US1_TX #23 US1_RX #22 US1_CLK #21 US1_CS #20 US1_CTS #19 US1_RTS #18 LEU0_TX #23 LEU0_RX #22 I2C0_SDA #23 I2C0_SCL #22	CMU_CLK1 #5 PRS_CH3 #14 PRS_CH4 #6 PRS_CH5 #5 PRS_CH6 #17 ACMP0_O #23 ACMP1_O #23 DBG_SWO #2							
17	PA0	ADC0_EXTN BUSCX BUSDY	TIM0_CC0 #0 TIM0_CC1 #31 TIM0_CC2 #30 TIM0_CDTI0 #29 TIM0_CDTI1 #28 TIM0_CDTI2 #27 TIM1_CC0 #0 TIM1_CC1 #31 TIM1_CC2 #30 TIM1_CC3 #29 LE- TIM0_OUT0 #0 LE- TIM0_OUT1 #31 PCNT0_S0IN #0 PCNT0_S1IN #31	US0_TX #0 US0_RX #31 US0_CLK #30 US0_CS #29 US0_CTS #28 US0_RTS #27 US1_TX #0 US1_RX #31 US1_CLK #30 US1_CS #29 US1_CTS #28 US1_RTS #27 LEU0_TX #0 LEU0_RX #31 I2C0_SDA #0 I2C0_SCL #31	CMU_CLK1 #0 PRS_CH6 #0 PRS_CH7 #10 PRS_CH8 #9 PRS_CH9 #8 ACMP0_O #0 ACMP1_O #0							
18	PA1	ADC0_EXTP BUSCY BUSDX	TIM0_CC0 #1 TIM0_CC1 #0 TIM0_CC2 #31 TIM0_CDTI0 #30 TIM0_CDTI1 #29 TIM0_CDTI2 #28 TIM1_CC0 #1 TIM1_CC1 #0 TIM1_CC2 #31 TIM1_CC3 #30 LE- TIM0_OUT0 #1 LE- TIM0_OUT0 #1 LE- TIM0_OUT1 #0 PCNT0_S0IN #1 PCNT0_S1IN #0	US0_TX #1 US0_RX #0 US0_CLK #31 US0_CS #30 US0_CTS #29 US0_RTS #28 US1_TX #1 US1_RX #0 US1_CLK #31 US1_CS #30 US1_CTS #29 US1_RTS #28 LEU0_TX #1 LEU0_RX #0 I2C0_SDA #1 I2C0_SCL #0	CMU_CLK0 #0 PRS_CH6 #1 PRS_CH7 #0 PRS_CH8 #10 PRS_CH9 #9 ACMP0_O #1 ACMP1_O #1							
19	PB11	BUSCY BUSDX	TIM0_CC0 #6 TIM0_CC1 #5 TIM0_CC2 #4 TIM0_CDTI0 #3 TIM0_CDTI1 #2 TIM0_CDTI2 #1 TIM1_CC0 #6 TIM1_CC1 #5 TIM1_CC2 #4 TIM1_CC3 #3 LE- TIM0_OUT0 #6 LE- TIM0_OUT0 #6 LE- TIM0_OUT1 #5 PCNT0_S0IN #6 PCNT0_S1IN #5	US0_TX #6 US0_RX #5 US0_CLK #4 US0_CS #3 US0_CTS #2 US0_RTS #1 US1_TX #6 US1_RX #5 US1_CLK #4 US1_CS #3 US1_CTS #2 US1_RTS #1 LEU0_TX #6 LEU0_RX #5 I2C0_SDA #6 I2C0_SCL #5	PRS_CH6 #6 PRS_CH7 #5 PRS_CH8 #4 PRS_CH9 #3 ACMP0_O #6 ACMP1_O #6							

Port	Bus	CH31	CH30	CH29	CH28	CH27	CH26	CH2	CH24	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16	CH1	CH1∡	СН1	CH12	CH11	CH10	СН9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	СНО
APORT1X	BUSAX										PF6		PF4		PF2		PF0						PC10		PC8		PC6						
APORT1Y	BUSAY									PF7		PF5		PF3		PF1						PC11		PC9		PC7							
APORT2X	BUSBX									PF7		PF5		PF3		PF1						PC11		PC9		PC7							
APORT2Y	BUSBY										PF6		PF4		PF2		PF0						PC10		PC8		PC6						
APORT3X	BUSCX		PB14		PB12																PA4		PA2		PA0		PD14		PD12		PD10		
APORT3Y	BUSCY	PB15		PB13		PB11														PA5		PA3		PA1		PD15		PD13		PD11		PD9	
APORT4X	BUSDX	PB15		PB13		PB11														PA5		PA3		PA1		PD15		PD13		PD11		PD9	
APORT4Y	BUSDY		PB14		PB12																PA4		PA2		PA0		PD14		PD12		PD10		

Table 6.10. ADC0 Bus and Pin Mapping

Table 6.11. IDAC0 Bus and Pin Mapping

Port	Bus	CH31	CH30	CH29	CH28	CH27	CH26	CH25	CH24	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16	CH15	CH14	CH13	CH12	CH11	CH10	СН9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0
APORT1X	BUSCX		PB14		PB12																PA4		PA2		PA0		PD14		PD12		PD10		
APORT1Y	BUSCY	PB15		PB13		PB11														PA5		PA3		PA1		PD15		PD13		PD11		PD9	

7. QFN48 Package Specifications

7.1 QFN48 Package Dimensions



Figure 7.1. QFN48 Package Drawing





The package marking consists of:

- PPPPPPPP The part number designation.
- TTTTTT A trace or manufacturing code. The first letter is the device revision.
- YY The last 2 digits of the assembly year.
- WW The 2-digit workweek when the device was assembled.
- # Reserved for future use. Current value is 0.

9. Revision History

9.1 Revision 1.1

2016-Oct-26

- · System Overview Sections: Minor wording and typographical error fixes.
- Electrical Characteristics: Minor wording and typographical error fixes.
- "HFRCO and AUXHFRCO" table in Electrical Characteristics: f_HFRCO symbol changed to f_HFRCO_ACC.
- Pinout tables: APORT channel details removed from "Analog" column. This information is now found in the APORT client map sections.
- Updated APORT client map sections.

9.2 Revision 1.0

2016-Jul-22

- Electrical Characteristics: Minimum and maximum value statement changed to cover full operating temperature range.
- Finalized Specification Tables. Tables with condition/min/typ/max or footnote changes include:
 - Absolute Maximum Ratings
 - · General Operating Conditions
 - DC-DC Converter
 - LFRCO
 - HFRCO and AUXHFRCO
 - ADC
 - IDAC
- Updated Typical Performance Graphs.
- · Added note for 5V tolerance to pinout GPIO Overview sections.
- · Updated OPN decoder with latest revision.
- · Updated Package Marking text with latest descriptions.

9.3 Revision 0.95

2016-04-11

- · All OPNs changed to rev C0.
- · Electrical specification tables updated with latest characterization data and production test limits.

9.4 Revision 0.31

· Engineering samples note added to ordering information table.

9.5 Revision 0.3

- · Re-formatted ordering information table and OPN decoder.
- · Removed extraneous sections from dc-dc from system overview.
- · Updated table formatting for electrical specifications.
- · Updated electrical specifications with latest available data.
- Added I2C and USART SPI timing tables.
- Moved dc-dc graph to typical performance curves.
- · Updated APORT tables and APORT references to correct nomenclature.
- Updated top marking description.

9.6 Revision 0.2

Updated ordering table.

Changed "1.62 V to 3.8 V Single Power Supply" to "1.62 V to 3.8 V Power Supply" in the Feature List.