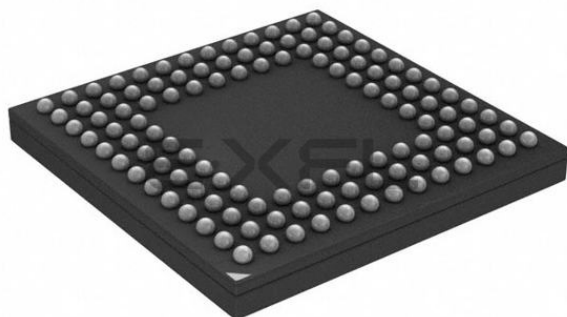




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### Applications of "[Embedded - Microcontrollers](#)"

#### Details

|                            |                                                                                                                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Status             | Obsolete                                                                                                                                                                |
| Core Processor             | ARM® Cortex®-M4                                                                                                                                                         |
| Core Size                  | 32-Bit Single-Core                                                                                                                                                      |
| Speed                      | 72MHz                                                                                                                                                                   |
| Connectivity               | CANbus, EBI/EMI, Ethernet, I <sup>2</sup> C, IrDA, LINbus, MMC/SD/SDIO, QSPI, SmartCard, SPI, UART/USART, USB                                                           |
| Peripherals                | Brown-out Detect/Reset, DMA, LCD, POR, PWM, WDT                                                                                                                         |
| Number of I/O              | 95                                                                                                                                                                      |
| Program Memory Size        | 2MB (2M x 8)                                                                                                                                                            |
| Program Memory Type        | FLASH                                                                                                                                                                   |
| EEPROM Size                | -                                                                                                                                                                       |
| RAM Size                   | 512K x 8                                                                                                                                                                |
| Voltage - Supply (Vcc/Vdd) | 1.8V ~ 3.8V                                                                                                                                                             |
| Data Converters            | A/D 16x12b SAR; D/A 2x12b                                                                                                                                               |
| Oscillator Type            | Internal                                                                                                                                                                |
| Operating Temperature      | -40°C ~ 125°C (TA)                                                                                                                                                      |
| Mounting Type              | Surface Mount                                                                                                                                                           |
| Package / Case             | 120-VFBGA                                                                                                                                                               |
| Supplier Device Package    | 120-BGA (7x7)                                                                                                                                                           |
| Purchase URL               | <a href="https://www.e-xfl.com/product-detail/silicon-labs/efm32gg11b820f2048il120-ar">https://www.e-xfl.com/product-detail/silicon-labs/efm32gg11b820f2048il120-ar</a> |

## 1. Feature List

The EFM32GG11 highlighted features are listed below.

- **ARM Cortex-M4 CPU platform**
  - High performance 32-bit processor @ up to 72 MHz
  - DSP instruction support and Floating Point Unit
  - Memory Protection Unit
  - Wake-up Interrupt Controller
- **Flexible Energy Management System**
  - 80  $\mu$ A/MHz in Active Mode (EM0)
  - 2.1  $\mu$ A EM2 Deep Sleep current (16 kB RAM retention and RTCC running from LFRCO)
- **Integrated DC-DC buck converter**
- **Up to 2048 kB flash program memory**
  - Dual-bank with read-while-write support
- **Up to 512 kB RAM data memory**
  - 256 kB with ECC (SEC-DED)
- **Octal/Quad-SPI Flash Memory Interface**
  - Supports 3 V and 1.8 V memories
  - 1/2/4/8-bit data bus
  - Quad-SPI Execute In Place (XIP)
- **Communication Interfaces**
  - Low-energy Universal Serial Bus (USB) with Device and Host support
    - Fully USB 2.0 compliant
    - On-chip PHY and embedded 5V to 3.3V regulator
    - Crystal-free Device mode operation
    - Patent-pending Low-Energy Mode (LEM)
  - SD/MMC/SDIO Host Controller
    - SD v3.01, SDIO v3.0 and MMC v4.51
    - 1/4/8-bit bus width
  - 10/100 Ethernet MAC with MII/RMII interface
    - IEEE1588-2008 precision time stamping
    - Energy Efficient Ethernet (802.3az)
  - Up to 2 $\times$  CAN Bus Controller
    - Version 2.0A and 2.0B up to 1 Mbps
  - 6 $\times$  Universal Synchronous/Asynchronous Receiver/ Transmitter
    - UART/SPI/SmartCard (ISO 7816)/IrDA/I2S/LIN
    - Triple buffered full/half-duplex operation with flow control
    - Ultra high speed (36 MHz) operation on one instance
  - 2 $\times$  Universal Asynchronous Receiver/ Transmitter
  - 2 $\times$  Low Energy UART
    - Autonomous operation with DMA in Deep Sleep Mode
  - 3 $\times$  I<sup>2</sup>C Interface with SMBus support
    - Address recognition in EM3 Stop Mode
- **Up to 144 General Purpose I/O Pins**
  - Configurable push-pull, open-drain, pull-up/down, input filter, drive strength
  - Configurable peripheral I/O locations
  - 5 V tolerance on select pins
  - Asynchronous external interrupts
  - Output state retention and wake-up from Shutoff Mode
- **Up to 24 Channel DMA Controller**
- **Up to 24 Channel Peripheral Reflex System (PRS) for autonomous inter-peripheral signaling**
- **External Bus Interface for up to 4x256 MB of external memory mapped space**
  - TFT Controller with Direct Drive
  - Per-pixel alpha-blending engine
- **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)
  - True Random Number Generator (TRNG)
- **Hardware CRC engine**
  - Single-cycle computation with 8/16/32-bit data and 16-bit (programmable)/32-bit (fixed) polynomial
- **Security Management Unit (SMU)**
  - Fine-grained access control for on-chip peripherals
- **Integrated Low-energy LCD Controller with up to 8 $\times$ 36 segments**
  - Voltage boost, contrast and autonomous animation
  - Patented low-energy LCD driver
- **Backup Power Domain**
  - RTCC and retention registers in a separate power domain, available down to energy mode EM4H
  - Operation from backup battery when main power absent/ insufficient
- **Ultra Low-Power Precision Analog Peripherals**
  - 2 $\times$  12-bit 1 Msamples/s Analog to Digital Converter (ADC)
    - On-chip temperature sensor
  - 2 $\times$  12-bit 500 ksamples/s Digital to Analog Converter (VDAC)
  - Digital to Analog Current Converter (IDAC)
  - Up to 4 $\times$  Analog Comparator (ACMP)
  - Up to 4 $\times$  Operational Amplifier (OPAMP)
  - Robust current-based capacitive sensing with up to 64 inputs and wake-on-touch (CSEN)
  - Up to 108 GPIO pins are analog-capable. Flexible analog peripheral-to-pin routing via Analog Port (APORT)
  - Supply Voltage Monitor

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| Parameter                                                                                                                                                                                                                                                                                                                                          | Symbol         | Test Condition                                                                                          | Min | Typ  | Max | Unit    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------|-----|------|-----|---------|
| Current consumption in EM3 mode, with voltage scaling enabled                                                                                                                                                                                                                                                                                      | $I_{EM3\_VS}$  | Full 512 kB RAM retention and CRYOTIMER running from ULFR-CO                                            | —   | 3.4  | —   | $\mu A$ |
| Current consumption in EM4H mode, with voltage scaling enabled                                                                                                                                                                                                                                                                                     | $I_{EM4H\_VS}$ | 128 byte RAM retention, RTCC running from LFXO                                                          | —   | 0.94 | —   | $\mu A$ |
|                                                                                                                                                                                                                                                                                                                                                    |                | 128 byte RAM retention, CRYO-TIMER running from ULFR-CO                                                 | —   | 0.56 | —   | $\mu A$ |
|                                                                                                                                                                                                                                                                                                                                                    |                | 128 byte RAM retention, no RTCC                                                                         | —   | 0.56 | —   | $\mu A$ |
| Current consumption in EM4S mode                                                                                                                                                                                                                                                                                                                   | $I_{EM4S}$     | No RAM retention, no RTCC                                                                               | —   | 0.1  | —   | $\mu A$ |
| Current consumption of peripheral power domain 1, with voltage scaling enabled                                                                                                                                                                                                                                                                     | $I_{PD1\_VS}$  | Additional current consumption in EM2/3 when any peripherals on power domain 1 are enabled <sup>1</sup> | —   | 0.68 | —   | $\mu A$ |
| Current consumption of peripheral power domain 2, with voltage scaling enabled                                                                                                                                                                                                                                                                     | $I_{PD2\_VS}$  | Additional current consumption in EM2/3 when any peripherals on power domain 2 are enabled <sup>1</sup> | —   | 0.28 | —   | $\mu A$ |
| <b>Note:</b> <ol style="list-style-type: none"> <li>1. Extra current consumed by power domain. Does not include current associated with the enabled peripherals. See <a href="#">3.2.4 EM2 and EM3 Power Domains</a> for a list of the peripherals in each power domain.</li> <li>2. CMU_LFRCTRL_ENVREF = 1, CMU_LFRCTRL_VREFUPDATE = 1</li> </ol> |                |                                                                                                         |     |      |     |         |

| Parameter                                                                        | Symbol           | Test Condition                         | Min | Typ      | Max | Unit          |
|----------------------------------------------------------------------------------|------------------|----------------------------------------|-----|----------|-----|---------------|
| Hysteresis ( $V_{CM} = 1.25\text{ V}$ , $BIASPROG^4 = 0x10$ , $FULLBIAS^4 = 1$ ) | $V_{ACMPHYST}$   | $HYSTSEL^5 = HYST0$                    | TBD | 0        | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST1$                    | TBD | 18       | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST2$                    | TBD | 33       | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST3$                    | TBD | 46       | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST4$                    | TBD | 57       | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST5$                    | TBD | 68       | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST6$                    | TBD | 79       | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST7$                    | TBD | 90       | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST8$                    | TBD | 0        | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST9$                    | TBD | -18      | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST10$                   | TBD | -33      | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST11$                   | TBD | -45      | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST12$                   | TBD | -57      | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST13$                   | TBD | -67      | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST14$                   | TBD | -78      | TBD | mV            |
|                                                                                  |                  | $HYSTSEL^5 = HYST15$                   | TBD | -88      | TBD | mV            |
| Comparator delay <sup>3</sup>                                                    | $t_{ACMPDELAY}$  | $BIASPROG^4 = 1$ , $FULLBIAS^4 = 0$    | —   | 30       | —   | $\mu\text{s}$ |
|                                                                                  |                  | $BIASPROG^4 = 0x10$ , $FULLBIAS^4 = 0$ | —   | 3.7      | —   | $\mu\text{s}$ |
|                                                                                  |                  | $BIASPROG^4 = 0x02$ , $FULLBIAS^4 = 1$ | —   | 360      | —   | ns            |
|                                                                                  |                  | $BIASPROG^4 = 0x20$ , $FULLBIAS^4 = 1$ | —   | 35       | —   | ns            |
| Offset voltage                                                                   | $V_{ACMPOFFSET}$ | $BIASPROG^4 = 0x10$ , $FULLBIAS^4 = 1$ | TBD | —        | TBD | mV            |
| Reference voltage                                                                | $V_{ACMPREF}$    | Internal 1.25 V reference              | TBD | 1.25     | TBD | V             |
|                                                                                  |                  | Internal 2.5 V reference               | TBD | 2.5      | TBD | V             |
| Capacitive sense internal resistance                                             | $R_{CSRES}$      | $CSRESSEL^6 = 0$                       | —   | infinite | —   | k $\Omega$    |
|                                                                                  |                  | $CSRESSEL^6 = 1$                       | —   | 15       | —   | k $\Omega$    |
|                                                                                  |                  | $CSRESSEL^6 = 2$                       | —   | 27       | —   | k $\Omega$    |
|                                                                                  |                  | $CSRESSEL^6 = 3$                       | —   | 39       | —   | k $\Omega$    |
|                                                                                  |                  | $CSRESSEL^6 = 4$                       | —   | 51       | —   | k $\Omega$    |
|                                                                                  |                  | $CSRESSEL^6 = 5$                       | —   | 100      | —   | k $\Omega$    |
|                                                                                  |                  | $CSRESSEL^6 = 6$                       | —   | 162      | —   | k $\Omega$    |
|                                                                                  |                  | $CSRESSEL^6 = 7$                       | —   | 235      | —   | k $\Omega$    |

#### 4.1.23.2 I2C Fast-mode (Fm)<sup>1</sup>

**Table 4.32. I2C Fast-mode (Fm)<sup>1</sup>**

| Parameter                                        | Symbol              | Test Condition | Min | Typ | Max | Unit |
|--------------------------------------------------|---------------------|----------------|-----|-----|-----|------|
| SCL clock frequency <sup>2</sup>                 | f <sub>SCL</sub>    |                | 0   | —   | 400 | kHz  |
| SCL clock low time                               | t <sub>LOW</sub>    |                | 1.3 | —   | —   | μs   |
| SCL clock high time                              | t <sub>HIGH</sub>   |                | 0.6 | —   | —   | μs   |
| SDA set-up time                                  | t <sub>SU_DAT</sub> |                | 100 | —   | —   | ns   |
| SDA hold time <sup>3</sup>                       | t <sub>HD_DAT</sub> |                | 100 | —   | 900 | ns   |
| Repeated START condition set-up time             | t <sub>SU_STA</sub> |                | 0.6 | —   | —   | μs   |
| (Repeated) START condition hold time             | t <sub>HD_STA</sub> |                | 0.6 | —   | —   | μs   |
| STOP condition set-up time                       | t <sub>SU_STO</sub> |                | 0.6 | —   | —   | μs   |
| Bus free time between a STOP and START condition | t <sub>BUF</sub>    |                | 1.3 | —   | —   | μs   |

**Note:**

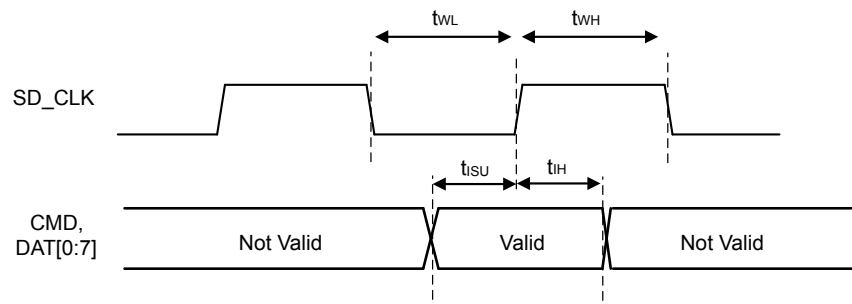
1. For CLHR set to 1 in the I2Cn\_CTRL register.
2. For the minimum HPERCLK frequency required in Fast-mode, refer to the I2C chapter in the reference manual.
3. The maximum SDA hold time (t<sub>HD,DAT</sub>) needs to be met only when the device does not stretch the low time of SCL (t<sub>LOW</sub>).

## 4.1.24 USART SPI

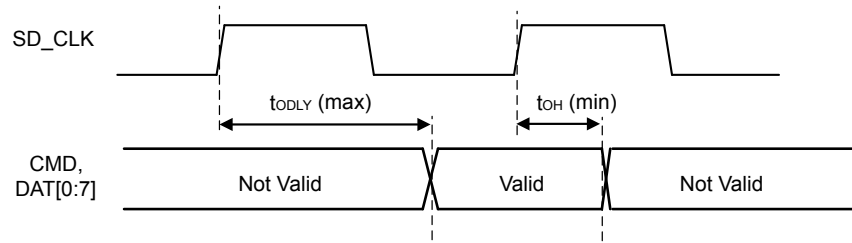
### SPI Master Timing

**Table 4.34. SPI Master Timing**

| Parameter                      | Symbol               | Test Condition                                | Min                           | Typ | Max | Unit |
|--------------------------------|----------------------|-----------------------------------------------|-------------------------------|-----|-----|------|
| SCLK period <sup>1 3 2</sup>   | t <sub>SCLK</sub>    | All USARTs except USART2                      | 2 *<br>t <sub>HFPERCLK</sub>  | —   | —   | ns   |
|                                |                      | USART2                                        | 2 *<br>t <sub>HFPERBCLK</sub> | —   | —   | ns   |
| CS to MOSI <sup>1 3</sup>      | t <sub>CS_MO</sub>   | USART2, location 4, IOVDD = 1.8 V             | -3.2                          | —   | 6.8 | ns   |
|                                |                      | USART2, location 4, IOVDD = 3.0 V             | -2.3                          | —   | 6.0 | ns   |
|                                |                      | USART2, location 5, IOVDD = 1.8 V             | -8.1                          | —   | 6.3 | ns   |
|                                |                      | USART2, location 5, IOVDD = 3.0 V             | -7.3                          | —   | 4.4 | ns   |
|                                |                      | All other USARTs and locations, IOVDD = 1.8 V | -15                           | —   | 13  | ns   |
|                                |                      | All other USARTs and locations, IOVDD = 3.0 V | -13                           | —   | 11  | ns   |
| SCLK to MOSI <sup>1 3</sup>    | t <sub>SCLK_MO</sub> | USART2, location 4, IOVDD = 1.8 V             | -0.3                          | —   | 9.2 | ns   |
|                                |                      | USART2, location 4, IOVDD = 3.0 V             | -0.3                          | —   | 8.6 | ns   |
|                                |                      | USART2, location 5, IOVDD = 1.8 V             | -3.6                          | —   | 5.0 | ns   |
|                                |                      | USART2, location 5, IOVDD = 3.0 V             | -3.4                          | —   | 3.2 | ns   |
|                                |                      | All other USARTs and locations, IOVDD = 1.8 V | -10                           | —   | 11  | ns   |
|                                |                      | All other USARTs and locations, IOVDD = 3.0 V | -9                            | —   | 11  | ns   |
| MISO setup time <sup>1 3</sup> | t <sub>SU_MI</sub>   | USART2, location 4, IOVDD = 1.8 V             | 39.7                          | —   | —   | ns   |
|                                |                      | USART2, location 4, IOVDD = 3.0 V             | 22.4                          | —   | —   | ns   |
|                                |                      | USART2, location 5, IOVDD = 1.8 V             | 49.2                          | —   | —   | ns   |
|                                |                      | USART2, location 5, IOVDD = 3.0 V             | 30.0                          | —   | —   | ns   |
|                                |                      | All other USARTs and locations, IOVDD = 1.8 V | 55                            | —   | —   | ns   |
|                                |                      | All other USARTs and locations, IOVDD = 3.0 V | 36                            | —   | —   | ns   |

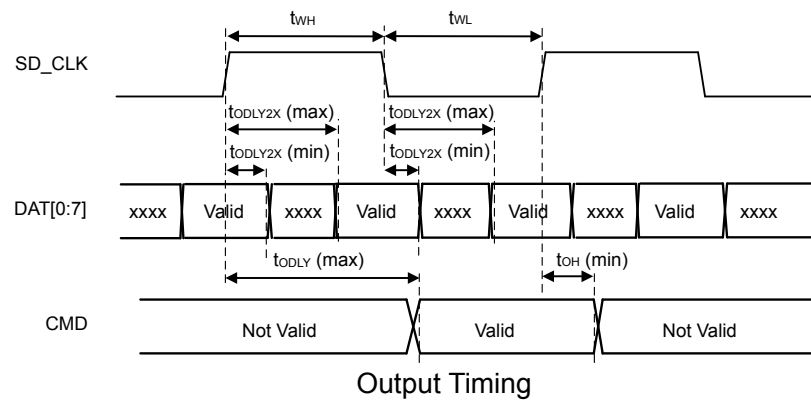
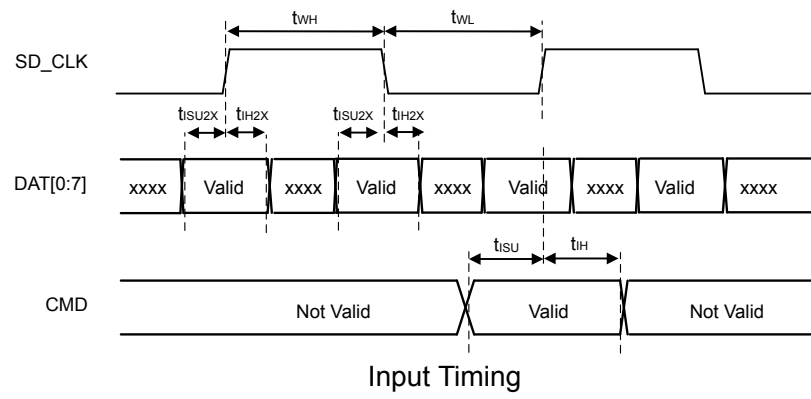


Input Timing



Output Timing

**Figure 4.17. SDIO MMC SDR Mode Timing**



**Figure 4.19. SDIO MMC DDR Mode Timing**

#### 4.1.28.2 QSPI DDR Mode

##### QSPI DDR Mode Timing (Location 0)

Timing is specified with voltage scaling disabled, PHY-mode, route location 0 only, TX DLL = 35, RX DLL = 70, 20-25 pF loading per GPIO, and slew rate for all GPIO set to 6, DRIVESTRENGTH = STRONG.

**Table 4.56. QSPI DDR Mode Timing (Location 0)**

| Parameter        | Symbol          | Test Condition           | Min                           | Typ | Max       | Unit |
|------------------|-----------------|--------------------------|-------------------------------|-----|-----------|------|
| Half SCLK period | T/2             | HFXO                     | $(1/F_{SCLK})^*$<br>0.4 - 0.4 | —   | —         | ns   |
|                  |                 | HFRCO, AUXHFRCO, USHFRCO | $(1/F_{SCLK})^*$<br>0.44      | —   | —         | ns   |
| Output valid     | t <sub>OV</sub> |                          | —                             | —   | T/2 - 5.0 | ns   |
| Output hold      | t <sub>OH</sub> |                          | T/2 - 39.4                    | —   | —         | ns   |
| Input setup      | t <sub>SU</sub> |                          | 33.1                          | —   | —         | ns   |
| Input hold       | t <sub>H</sub>  |                          | -0.9                          | —   | —         | ns   |

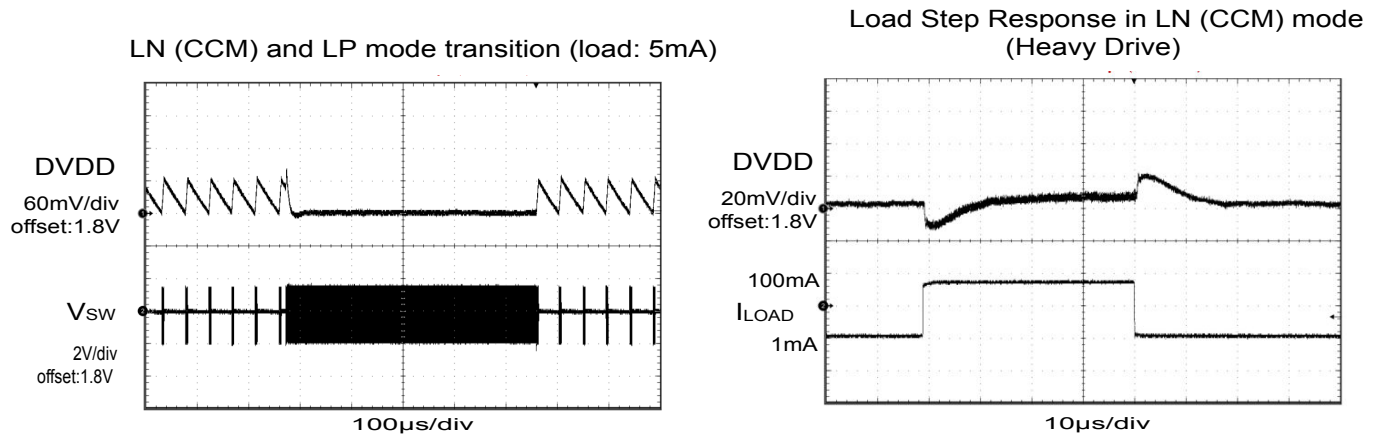
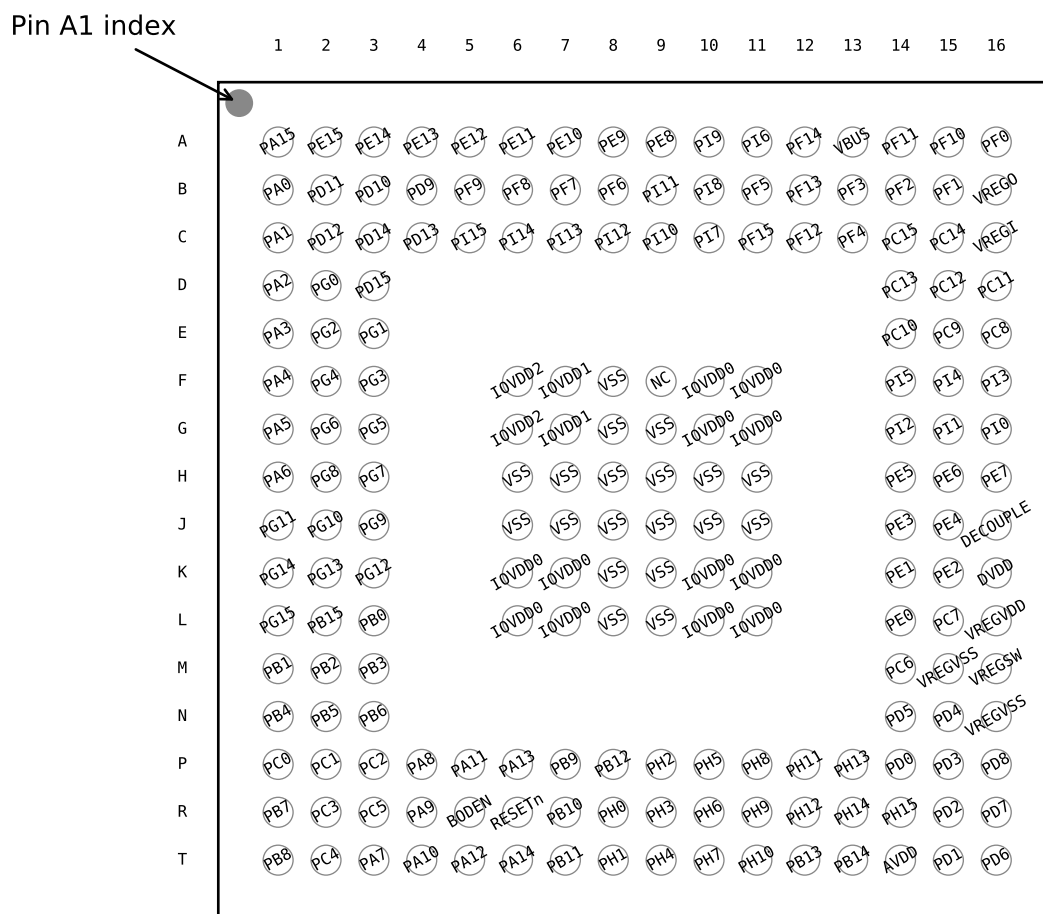


Figure 4.30. DC-DC Converter Transition Waveforms

## 5. Pin Definitions

### 5.1 EFM32GG11B8xx in BGA192 Device Pinout



**Figure 5.1. EFM32GG11B8xx in BGA192 Device Pinout**

The following table provides package pin connections and general descriptions of pin functionality. For detailed information on the supported features for each GPIO pin, see [5.20 GPIO Functionality Table](#) or [5.21 Alternate Functionality Overview](#).

**Table 5.1. EFM32GG11B8xx in BGA192 Device Pinout**

| Pin Name | Pin(s) | Description | Pin Name | Pin(s) | Description |
|----------|--------|-------------|----------|--------|-------------|
| PA15     | A1     | GPIO        | PE15     | A2     | GPIO        |
| PE14     | A3     | GPIO        | PE13     | A4     | GPIO        |
| PE12     | A5     | GPIO        | PE11     | A6     | GPIO        |
| PE10     | A7     | GPIO        | PE9      | A8     | GPIO        |
| PE8      | A9     | GPIO        | PI9      | A10    | GPIO (5V)   |
| PI6      | A11    | GPIO (5V)   | PF14     | A12    | GPIO (5V)   |

| Pin Name | Pin(s)                                    | Description                                                                                              | Pin Name | Pin(s)                        | Description                |
|----------|-------------------------------------------|----------------------------------------------------------------------------------------------------------|----------|-------------------------------|----------------------------|
| PF11     | A13                                       | GPIO (5V)                                                                                                | PA15     | B1                            | GPIO                       |
| PE13     | B2                                        | GPIO                                                                                                     | PE11     | B3                            | GPIO                       |
| PE8      | B4                                        | GPIO                                                                                                     | PD12     | B5                            | GPIO                       |
| PD10     | B6                                        | GPIO                                                                                                     | PF8      | B7                            | GPIO                       |
| PF6      | B8                                        | GPIO                                                                                                     | PF13     | B9                            | GPIO (5V)                  |
| PF4      | B10                                       | GPIO                                                                                                     | PF3      | B11                           | GPIO                       |
| NC       | B12                                       | No Connect.                                                                                              | PF10     | B13                           | GPIO (5V)                  |
| PA1      | C1                                        | GPIO                                                                                                     | PA0      | C2                            | GPIO                       |
| PE10     | C3                                        | GPIO                                                                                                     | PD13     | C4                            | GPIO (5V)                  |
| VSS      | C5<br>C8<br>H3<br>J3<br>K11<br>L12<br>L15 | Ground                                                                                                   | IOVDD1   | C6                            | Digital IO power supply 1. |
| PF9      | C7                                        | GPIO                                                                                                     | IOVDD0   | C9<br>J11<br>K3<br>L11<br>L16 | Digital IO power supply 0. |
| PF2      | C10                                       | GPIO                                                                                                     | PF1      | C11                           | GPIO (5V)                  |
| PC14     | C12                                       | GPIO (5V)                                                                                                | PC15     | C13                           | GPIO (5V)                  |
| PA3      | D1                                        | GPIO                                                                                                     | PA2      | D2                            | GPIO                       |
| PB15     | D3                                        | GPIO (5V)                                                                                                | PF0      | D11                           | GPIO (5V)                  |
| PC12     | D12                                       | GPIO (5V)                                                                                                | PC13     | D13                           | GPIO (5V)                  |
| PA6      | E1                                        | GPIO                                                                                                     | PA5      | E2                            | GPIO                       |
| PA4      | E3                                        | GPIO                                                                                                     | PC9      | E11                           | GPIO (5V)                  |
| PC10     | E12                                       | GPIO (5V)                                                                                                | PC11     | E13                           | GPIO (5V)                  |
| PB0      | F1                                        | GPIO                                                                                                     | PB1      | F2                            | GPIO                       |
| PB2      | F3                                        | GPIO                                                                                                     | PE6      | F11                           | GPIO                       |
| PE7      | F12                                       | GPIO                                                                                                     | PC8      | F13                           | GPIO (5V)                  |
| PB3      | G1                                        | GPIO                                                                                                     | PB4      | G2                            | GPIO                       |
| IOVDD2   | G3                                        | Digital IO power supply 2.                                                                               | PE3      | G11                           | GPIO                       |
| PE4      | G12                                       | GPIO                                                                                                     | PE5      | G13                           | GPIO                       |
| PB5      | H1                                        | GPIO                                                                                                     | PB6      | H2                            | GPIO                       |
| DVDD     | H11                                       | Digital power supply.                                                                                    | PE2      | H12                           | GPIO                       |
| DECOUPLE | H13                                       | Decouple output for on-chip voltage regulator. An external decoupling capacitor is required at this pin. | PD14     | J1                            | GPIO (5V)                  |
| PD15     | J2                                        | GPIO (5V)                                                                                                | PE1      | J12                           | GPIO (5V)                  |
| VREGVDD  | J13                                       | Voltage regulator VDD input                                                                              | PC0      | K1                            | GPIO (5V)                  |

| Pin Name | Pin(s)          | Description          | Pin Name | Pin(s) | Description                                                                                                                                                                                 |
|----------|-----------------|----------------------|----------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PC1      | J1              | GPIO (5V)            | PC3      | J2     | GPIO (5V)                                                                                                                                                                                   |
| PD15     | J3              | GPIO (5V)            | PA12     | J4     | GPIO (5V)                                                                                                                                                                                   |
| PA9      | J5              | GPIO                 | PA10     | J6     | GPIO                                                                                                                                                                                        |
| PB9      | J7              | GPIO (5V)            | PB10     | J8     | GPIO (5V)                                                                                                                                                                                   |
| PD2      | J9              | GPIO (5V)            | PD3      | J10    | GPIO                                                                                                                                                                                        |
| PD4      | J11             | GPIO                 | PB7      | K1     | GPIO                                                                                                                                                                                        |
| PC4      | K2              | GPIO                 | PA13     | K3     | GPIO (5V)                                                                                                                                                                                   |
| PA11     | K5              | GPIO                 | RESETn   | K6     | Reset input, active low. To apply an external reset source to this pin, it is required to only drive this pin low during reset, and let the internal pull-up ensure that reset is released. |
| AVDD     | K8<br>K9<br>L10 | Analog power supply. | PD1      | K11    | GPIO                                                                                                                                                                                        |
| PB8      | L1              | GPIO                 | PC5      | L2     | GPIO                                                                                                                                                                                        |
| PA14     | L3              | GPIO                 | PB11     | L5     | GPIO                                                                                                                                                                                        |
| PB12     | L6              | GPIO                 | PB13     | L8     | GPIO                                                                                                                                                                                        |
| PB14     | L9              | GPIO                 | PD0      | L11    | GPIO (5V)                                                                                                                                                                                   |

**Note:**

1. GPIO with 5V tolerance are indicated by (5V).
2. The pins PD13, PD14, and PD15 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.

| Pin Name | Pin(s) | Description                                                                                                                                                                                 | Pin Name | Pin(s)   | Description             |
|----------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|-------------------------|
| PB6      | 12     | GPIO                                                                                                                                                                                        | PC4      | 13       | GPIO                    |
| PC5      | 14     | GPIO                                                                                                                                                                                        | PB7      | 15       | GPIO                    |
| PB8      | 16     | GPIO                                                                                                                                                                                        | PA12     | 17       | GPIO (5V)               |
| PA13     | 18     | GPIO (5V)                                                                                                                                                                                   | PA14     | 19       | GPIO                    |
| RESETn   | 20     | Reset input, active low. To apply an external reset source to this pin, it is required to only drive this pin low during reset, and let the internal pull-up ensure that reset is released. | PB11     | 21       | GPIO                    |
| PB12     | 22     | GPIO                                                                                                                                                                                        | AVDD     | 23<br>27 | Analog power supply.    |
| PB13     | 24     | GPIO                                                                                                                                                                                        | PB14     | 25       | GPIO                    |
| PD0      | 28     | GPIO (5V)                                                                                                                                                                                   | PD1      | 29       | GPIO                    |
| PD2      | 30     | GPIO (5V)                                                                                                                                                                                   | PD3      | 31       | GPIO                    |
| PD4      | 32     | GPIO                                                                                                                                                                                        | PD5      | 33       | GPIO                    |
| PD6      | 34     | GPIO                                                                                                                                                                                        | PD7      | 35       | GPIO                    |
| PD8      | 36     | GPIO                                                                                                                                                                                        | PC6      | 37       | GPIO                    |
| PC7      | 38     | GPIO                                                                                                                                                                                        | DVDD     | 39       | Digital power supply.   |
| DECOUPLE | 40     | Decouple output for on-chip voltage regulator. An external decoupling capacitor is required at this pin.                                                                                    | PE4      | 41       | GPIO                    |
| PE5      | 42     | GPIO                                                                                                                                                                                        | PE6      | 43       | GPIO                    |
| PE7      | 44     | GPIO                                                                                                                                                                                        | VREGI    | 45       | Input to 5 V regulator. |
| VREGO    | 46     | Decoupling for 5 V regulator and regulator output. Power for USB PHY in USB-enabled OPNs                                                                                                    | PF10     | 47       | GPIO (5V)               |
| PF11     | 48     | GPIO (5V)                                                                                                                                                                                   | PF0      | 49       | GPIO (5V)               |
| PF1      | 50     | GPIO (5V)                                                                                                                                                                                   | PF2      | 51       | GPIO                    |
| VBUS     | 52     | USB VBUS signal and auxiliary input to 5 V regulator.                                                                                                                                       | PF12     | 53       | GPIO                    |
| PF5      | 54     | GPIO                                                                                                                                                                                        | PE8      | 56       | GPIO                    |
| PE9      | 57     | GPIO                                                                                                                                                                                        | PE10     | 58       | GPIO                    |
| PE11     | 59     | GPIO                                                                                                                                                                                        | PE12     | 60       | GPIO                    |
| PE13     | 61     | GPIO                                                                                                                                                                                        | PE14     | 62       | GPIO                    |
| PE15     | 63     | GPIO                                                                                                                                                                                        | PA15     | 64       | GPIO                    |

**Note:**

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

| GPIO Name | Pin Alternate Functionality / Description |                                                  |                                                            |                                                                                               |                                                                                 |
|-----------|-------------------------------------------|--------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
|           | Analog                                    | EBI                                              | Timers                                                     | Communication                                                                                 | Other                                                                           |
| PF7       | BUSCY BUSDX<br>LCD_SEG25                  | EBI_BL1 #0 EBI_BL1 #4<br>EBI_BL1 #5 EBI_DCLK #1  | TIM0_CC1 #1<br>TIM4_CC1 #4                                 | ETH_RMIITXD0 #1<br>US2_RX #4<br>QSPI0_CS0 #0<br>ETH_MIIRXER #2<br>US1_RX #3 U0_RX #0          | PRS_CH23 #2                                                                     |
| PF6       | BUSDY BUSCX<br>LCD_SEG24                  | EBI_BL0 #0 EBI_BL0 #4<br>EBI_BL0 #5 EBI_CSTFT #1 | TIM0_CC0 #1<br>TIM4_CC0 #4<br>WTIM3_CC2 #5                 | ETH_RMIITXD1 #1<br>US2_TX #4<br>QSPI0_SCLK #0<br>US1_TX #3 U0_TX #0                           | PRS_CH22 #2                                                                     |
| PI11      |                                           |                                                  |                                                            | US4_RTS #3                                                                                    |                                                                                 |
| PI8       |                                           | EBI_A13 #2                                       | TIM1_CC2 #7<br>TIM4_CC0 #3                                 | US4_CLK #3                                                                                    |                                                                                 |
| PF5       | BUSCY BUSDX<br>LCD_SEG3                   | EBI_REn #0<br>EBI_REn #5 EBI_A27 #1              | TIM0_CDTI2 #2<br>TIM1_CC3 #6<br>TIM4_CC0 #2                | US2_CS #5<br>I2C2_SCL #0<br>USB_VBUSEN                                                        | PRS_CH2 #1<br>DBG_TDI                                                           |
| PF13      | BUSCY BUSDX                               |                                                  | TIM1_CC0 #6<br>TIM4_CC0 #1<br>TIM5_CC1 #7<br>WTIM3_CC0 #7  | US5_CLK #2<br>I2C2_SDA #4                                                                     |                                                                                 |
| PF3       | BUSCY BUSDX<br>LCD_SEG1                   | EBI_ALE #0                                       | TIM4_CC0 #0<br>TIM0_CDTI0 #2<br>TIM1_CC1 #5                | CAN1_TX #1<br>US1_CTS #2<br>I2C2_SCL #5                                                       | CMU_CLK1 #4<br>PRS_CH0 #1<br>ETM_TD3 #1                                         |
| PF2       | BUSDY BUSCX<br>LCD_SEG0                   | EBI_ARDY #0<br>EBI_A26 #1                        | TIM0_CC2 #4<br>TIM1_CC0 #5<br>TIM2_CC0 #3                  | US2_CLK #5<br>CAN0_TX #1<br>US1_TX #5 U0_RX #5<br>LEU0_TX #4 I2C1_SCL #4                      | CMU_CLK0 #4<br>PRS_CH0 #3<br>ACMP1_O #0<br>DBG_TDO<br>DBG_SWO #0<br>GPIO_EM4WU4 |
| PF1       | BUSCY BUSDX                               | EBI_A25 #1                                       | TIM0_CC1 #4<br>WTIM0_CC2 #4 LE-<br>TIM0_OUT1 #2            | US2_RX #5<br>CAN1_RX #1<br>US1_CS #2 U0_TX #5<br>LEU0_RX #3 I2C0_SCL #5                       | PRS_CH4 #2<br>DBG_SWDIOTMS<br>GPIO_EM4WU3<br>BOOT_RX                            |
| PA1       | BUSAY USBX<br>LCD_SEG14                   | EBI_AD10 #0<br>EBI_DCLK #3                       | TIM0_CC0 #7<br>TIM0_CC1 #0<br>TIM3_CC1 #4<br>PCNT0_S1IN #4 | ETH_RMIIRXD1 #0<br>ETH_MIITXD3 #0<br>SDIO_DAT1 #1<br>US3_RX #0<br>QSPI0_CS1 #1<br>I2C0_SCL #0 | CMU_CLK1 #0<br>PRS_CH1 #0                                                       |
| PD12      | LCD_SEG31                                 | EBI_CS3 #0                                       | TIM4_CC1 #6                                                | ETH_RMIIRXER #1<br>SDIO_DAT4 #0<br>QSPI0_DQ3 #0<br>ETH_MIIRXCLK #2<br>US4_CS #1               |                                                                                 |
| PD14      |                                           | EBI_NANDWEn #1                                   | TIM2_CDTI1 #1<br>TIM3_CC2 #6<br>WTIM0_CC2 #1               | ETH_MDC #1<br>CAN0_RX #5<br>US4_RTS #1<br>US5_CS #1<br>I2C0_SDA #3                            |                                                                                 |

| GPIO Name | Pin Alternate Functionality / Description              |                                                                     |                                                                                               |                                                                                                         |                                                         |
|-----------|--------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
|           | Analog                                                 | EBI                                                                 | Timers                                                                                        | Communication                                                                                           | Other                                                   |
| PD4       | BUSADC0Y BU-SADC0X OPA2_P                              | EBI_A08 #1 EBI_A17 #3                                               | TIM6_CC0 #7<br>WTIM0_CDTI0 #4<br>WTIM1_CC2 #1<br>WTIM2_CC1 #5                                 | CAN1_TX #2<br>US1_CTS #1<br>US3_CLK #2<br>LEU0_TX #0<br>I2C1_SDA #3                                     | CMU_CLKI0 #0<br>PRS_CH10 #2<br>ETM_TD2 #0<br>ETM_TD2 #2 |
| PC0       | VDAC0_OUT0ALT / OPA0_OUTALT #0<br>BUSACMP0Y BU-SACMP0X | EBI_AD07 #1<br>EBI_CS0 #2<br>EBI_REn #3<br>EBI_A23 #0               | TIM0_CC1 #3<br>TIM2_CC1 #4<br>PCNT0_S0IN #2                                                   | ETH_MDIO #2<br>CAN0_RX #0<br>US0_TX #5 US1_TX #0<br>US1_CS #4<br>US2_RTS #0<br>US3_CS #3<br>I2C0_SDA #4 | LES_CH0 PRS_CH2 #0                                      |
| PC1       | VDAC0_OUT0ALT / OPA0_OUTALT #1<br>BUSACMP0Y BU-SACMP0X | EBI_AD08 #1<br>EBI_CS1 #2<br>EBI_BL0 #3 EBI_A24 #0                  | TIM0_CC2 #3<br>TIM2_CC2 #4<br>WTIM0_CC0 #7<br>PCNT0_S1IN #2                                   | ETH_MDC #2<br>CAN0_TX #0<br>US0_RX #5 US1_TX #4<br>US1_RX #0<br>US2_CTS #0<br>US3_RTS #1<br>I2C0_SCL #4 | LES_CH1 PRS_CH3 #0                                      |
| PC2       | VDAC0_OUT0ALT / OPA0_OUTALT #2<br>BUSACMP0Y BU-SACMP0X | EBI_AD09 #1<br>EBI_CS2 #2<br>EBI_NANDWEn #3<br>EBI_A25 #0           | TIM0_CDTI0 #3<br>TIM2_CC0 #5<br>WTIM0_CC1 #7 LE-TIM1_OUT0 #3                                  | ETH_TSUEXTCLK #2<br>CAN1_RX #0<br>US1_RX #4 US2_TX #0                                                   | LES_CH2 PRS_CH10 #1                                     |
| PA8       | BUSBY BUSAX LCD_SEG36                                  | EBI_AD14 #1<br>EBI_A02 #3<br>EBI_DCLK #0                            | TIM2_CC0 #0<br>TIM0_CC0 #6 LE-TIM0_OUT0 #6<br>PCNT1_S1IN #4                                   | US2_RX #2<br>US4_RTS #0                                                                                 | PRS_CH8 #0                                              |
| PA11      | BUSAY BUSBX LCD_SEG39                                  | EBI_CS1 #1<br>EBI_A05 #3<br>EBI_HSNC #0                             | WTIM2_CC2 #0 LE-TIM1_OUT0 #1                                                                  | US2_CTS #2                                                                                              | PRS_CH11 #0                                             |
| PA13      | BUSAY BUSBX                                            | EBI_WEn #1<br>EBI_NANDWEn #2<br>EBI_A01 #0 EBI_A07 #3               | TIM0_CC2 #7<br>TIM2_CC1 #1<br>WTIM0_CDTI1 #2<br>WTIM2_CC1 #1 LE-TIM1_OUT1 #1<br>PCNT1_S1IN #5 | CAN1_TX #5<br>US0_CS #5 US2_TX #3                                                                       | PRS_CH13 #0                                             |
| PB9       | BUSAY BUSBX                                            | EBI_ALE #1<br>EBI_NANDREn #2<br>EBI_A00 #1 EBI_A03 #0<br>EBI_A09 #3 | WTIM2_CC0 #2 LE-TIM0_OUT0 #7                                                                  | SDIO_WP #3<br>CAN0_RX #3<br>US1_CTS #0 U1_TX #2                                                         | PRS_CH13 #1<br>ACMP1_O #5                               |
| PB12      | BUSBY BUSAX<br>VDAC0_OUT1 / OPA1_OUT                   | EBI_A03 #1 EBI_A12 #3<br>EBI_CSTFT #2                               | TIM1_CC3 #3<br>WTIM2_CC0 #3 LE-TIM0_OUT1 #1<br>PCNT0_S0IN #7<br>PCNT1_S1IN #6                 | US2_CTS #1<br>US5_RTS #0<br>U1_RTS #2<br>I2C1_SCL #1                                                    | PRS_CH16 #1                                             |
| PH2       | BUSADC1Y BU-SADC1X                                     | EBI_VSNC #2                                                         | TIM6_CC0 #3                                                                                   | US1_CTS #6                                                                                              |                                                         |
| PH5       | BUSADC1Y BU-SADC1X                                     | EBI_A17 #2                                                          | TIM6_CDTI0 #3<br>WTIM2_CC1 #6                                                                 | US4_RX #4                                                                                               |                                                         |
| PH8       | BUSACMP3Y BU-SACMP3X                                   | EBI_A20 #2                                                          | TIM6_CC0 #4<br>WTIM1_CC0 #6<br>WTIM2_CC1 #7                                                   | US4_CTS #4                                                                                              |                                                         |

| Alternate     | LOCATION                               |                                         |                                          |
|---------------|----------------------------------------|-----------------------------------------|------------------------------------------|
| Functionality | 0 - 3                                  | 4 - 7                                   | Description                              |
| PCNT0_S0IN    | 0: PC13<br>1: PE0<br>2: PC0<br>3: PD6  | 4: PA0<br>5: PB0<br>6: PB5<br>7: PB12   | Pulse Counter PCNT0 input number 0.      |
| PCNT0_S1IN    | 0: PC14<br>1: PE1<br>2: PC1<br>3: PD7  | 4: PA1<br>5: PB1<br>6: PB6<br>7: PB11   | Pulse Counter PCNT0 input number 1.      |
| PCNT1_S0IN    | 0: PA5<br>1: PB3<br>2: PD15<br>3: PC4  | 4: PA7<br>5: PA12<br>6: PB11<br>7: PG14 | Pulse Counter PCNT1 input number 0.      |
| PCNT1_S1IN    | 0: PA6<br>1: PB4<br>2: PB0<br>3: PC5   | 4: PA8<br>5: PA13<br>6: PB12<br>7: PG15 | Pulse Counter PCNT1 input number 1.      |
| PCNT2_S0IN    | 0: PD0<br>1: PE8<br>2: PB13<br>3: PF10 | 4: PC12<br>5: PI2<br>6: PI0<br>7: PH14  | Pulse Counter PCNT2 input number 0.      |
| PCNT2_S1IN    | 0: PD1<br>1: PE9<br>2: PB14<br>3: PF11 | 4: PC13<br>5: PI1<br>6: PH15<br>7: PH13 | Pulse Counter PCNT2 input number 1.      |
| PRS_CH0       | 0: PA0<br>1: PF3<br>2: PC14<br>3: PF2  |                                         | Peripheral Reflex System PRS, channel 0. |
| PRS_CH1       | 0: PA1<br>1: PF4<br>2: PC15<br>3: PE12 |                                         | Peripheral Reflex System PRS, channel 1. |
| PRS_CH2       | 0: PC0<br>1: PF5<br>2: PE10<br>3: PE13 |                                         | Peripheral Reflex System PRS, channel 2. |
| PRS_CH3       | 0: PC1<br>1: PE8<br>2: PE11<br>3: PA0  |                                         | Peripheral Reflex System PRS, channel 3. |
| PRS_CH4       | 0: PC8<br>1: PB0<br>2: PF1             |                                         | Peripheral Reflex System PRS, channel 4. |
| PRS_CH5       | 0: PC9<br>1: PB1<br>2: PD6             |                                         | Peripheral Reflex System PRS, channel 5. |
| PRS_CH6       | 0: PA6<br>1: PB14<br>2: PE6            |                                         | Peripheral Reflex System PRS, channel 6. |

| Alternate Functionality | Location | Priority         |
|-------------------------|----------|------------------|
| QSPI0_DQS               | 0: PF9   | High Speed       |
| QSPI0_SCLK              | 0: PF6   | High Speed       |
| SDIO_CLK                | 0: PE13  | High Speed       |
| SDIO_CMD                | 0: PE12  | High Speed       |
| SDIO_DAT0               | 0: PE11  | High Speed       |
| SDIO_DAT1               | 0: PE10  | High Speed       |
| SDIO_DAT2               | 0: PE9   | High Speed       |
| SDIO_DAT3               | 0: PE8   | High Speed       |
| SDIO_DAT4               | 0: PD12  | High Speed       |
| SDIO_DAT5               | 0: PD11  | High Speed       |
| SDIO_DAT6               | 0: PD10  | High Speed       |
| SDIO_DAT7               | 0: PD9   | High Speed       |
| TIM0_CC0                | 3: PB6   | Non-interference |
| TIM0_CC1                | 3: PC0   | Non-interference |
| TIM0_CC2                | 3: PC1   | Non-interference |
| TIM0_CDTI0              | 1: PC13  | Non-interference |
| TIM0_CDTI1              | 1: PC14  | Non-interference |
| TIM0_CDTI2              | 1: PC15  | Non-interference |
| TIM2_CC0                | 0: PA8   | Non-interference |
| TIM2_CC1                | 0: PA9   | Non-interference |
| TIM2_CC2                | 0: PA10  | Non-interference |
| TIM2_CDTI0              | 0: PB0   | Non-interference |
| TIM2_CDTI1              | 0: PB1   | Non-interference |
| TIM2_CDTI2              | 0: PB2   | Non-interference |
| TIM4_CC0                | 0: PF3   | Non-interference |
| TIM4_CC1                | 0: PF4   | Non-interference |
| TIM4_CC2                | 0: PF12  | Non-interference |
| TIM4_CDTI0              | 0: PD0   | Non-interference |
| TIM4_CDTI1              | 0: PD1   | Non-interference |
| TIM4_CDTI2              | 0: PD3   | Non-interference |
| TIM6_CC0                | 0: PG0   | Non-interference |
| TIM6_CC1                | 0: PG1   | Non-interference |
| TIM6_CC2                | 0: PG2   | Non-interference |
| TIM6_CDTI0              | 0: PG3   | Non-interference |
| TIM6_CDTI1              | 0: PG4   | Non-interference |
| TIM6_CDTI2              | 0: PG5   | Non-interference |

Table 5.26. ACMP3 Bus and Pin Mapping

| APORT4Y | APORT4X | APORT3Y | APORT3X | APORT2Y | APORT2X | APORT1Y | APORT1X | APORT0Y | APORT0X | Port |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| BUSDY   | BUSDY   | BUSDY   | BUSDY   | BUSDY   | BUSDY   | BUSDY   | BUSDY   | BUSDY   | BUSDY   | Bus  |
| PF14    | PF15    | PF15    | PF14    | PF14    | PF15    | PF15    | PF14    |         |         | CH31 |
|         | PF13    | PF13    |         | PF14    | PF13    | PF13    | PF14    |         |         | CH30 |
| PF12    |         |         | PF12    | PF12    |         |         | PF12    |         |         | CH29 |
|         | PF11    | PF11    |         |         | PF11    | PF11    |         |         |         | CH28 |
| PF10    |         |         | PF10    | PF10    |         |         | PF10    |         |         | CH27 |
|         | PF9     | PF9     |         |         | PF9     | PF9     |         |         |         | CH26 |
| PF8     |         |         | PF8     |         |         |         |         |         |         | CH25 |
|         | PF7     | PF7     |         |         |         |         |         |         |         | CH24 |
| PF6     |         |         | PF6     | PF6     |         |         | PF6     |         |         | CH23 |
|         | PF5     | PF5     |         |         | PF5     | PF5     |         |         |         | CH22 |
| PF4     |         |         | PF4     | PF4     |         |         | PF4     |         |         | CH21 |
|         | PF3     | PF3     |         |         | PF3     | PF3     |         |         |         | CH20 |
| PF2     |         |         | PF2     | PF2     |         |         | PF2     |         |         | CH19 |
|         | PF1     | PF1     |         |         | PF1     | PF1     |         |         |         | CH18 |
| PF0     |         |         | PF0     | PF0     |         |         | PF0     |         |         | CH17 |
|         | PE15    | PE15    |         |         | PE15    | PE15    |         |         |         | CH16 |
| PE14    |         |         | PE14    | PE14    |         |         | PE14    |         |         | CH15 |
|         | PE13    | PE13    |         |         | PE13    | PE13    |         |         |         | CH14 |
| PE12    |         |         | PE12    | PE12    |         |         | PE12    |         |         | CH13 |
|         | PE11    | PE11    |         |         | PE11    | PE11    |         |         |         | CH12 |
| PE10    |         |         | PE10    | PE10    |         |         | PE10    |         |         | CH11 |
|         | PE9     | PE9     |         |         | PE9     | PE9     |         |         |         | CH10 |
| PE8     |         |         | PE8     | PE8     |         |         | PE8     |         |         | CH9  |
|         | PE7     | PE7     |         |         | PE7     | PE7     |         |         |         | CH8  |
| PE6     |         |         | PE6     | PE6     |         |         | PE6     | PH15    | PH15    | CH7  |
|         | PE5     | PE5     |         |         | PE5     | PE5     |         | PH14    | PH14    | CH6  |
| PE4     |         |         | PE4     | PE4     |         | PE4     |         | PH13    | PH13    | CH5  |
|         |         |         |         |         | PE3     | PE3     |         | PH12    | PH12    | CH4  |
|         |         |         |         |         | PE2     | PE2     |         | PH11    | PH11    | CH3  |
|         | PE1     | PE1     |         | PE2     |         |         | PE2     | PH10    | PH10    | CH2  |
|         |         |         |         |         | PE1     | PE1     |         | PH9     | PH9     | CH1  |
| PE0     |         |         | PE0     | PE0     |         |         | PE0     | PH8     | PH8     | CH0  |

**Table 9.2. BGA112 PCB Land Pattern Dimensions**

| Dimension | Min | Nom  | Max |
|-----------|-----|------|-----|
| X         |     | 0.45 |     |
| C1        |     | 8.00 |     |
| C2        |     | 8.00 |     |
| E1        |     | 0.8  |     |
| E2        |     | 0.8  |     |

**Note:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing is per the ANSI Y14.5M-1994 specification.
3. This Land Pattern Design is based on the IPC-7351 guidelines.
4. All metal pads are to be non-solder mask defined (NSMD). Clearance between the solder mask and the metal pad is to be 60 µm minimum, all the way around the pad.
5. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
6. The stencil thickness should be 0.125 mm (5 mils).
7. The ratio of stencil aperture to land pad size should be 1:1.
8. A No-Clean, Type-3 solder paste is recommended.
9. The recommended card reflow profile is per the JEDEC/IPC J-STD-020C specification for Small Body Components.