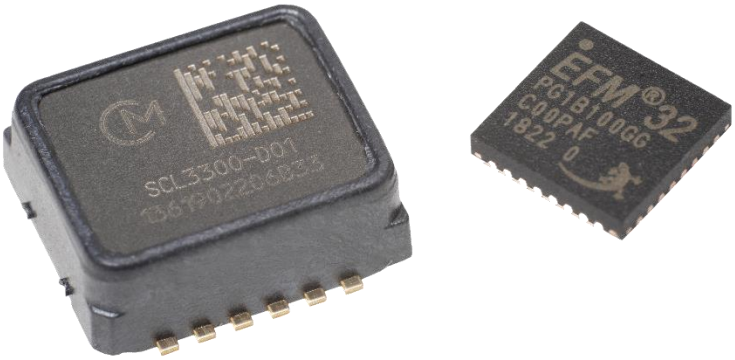
BCGMCU PRODUCT SPECIFICATION



BCGMCU-D01

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1 Introduction

The BCGMCU is the next generation of Murata's Ballistocardiographic (BCG) technology. The product is a microcontroller pre-programmed with the Murata BCG algorithm, which is coupled together with the low noise SCL3300 inclinometer in customers product PCB designs. The low integration level design allows for the integration of BCG measurement into a wide range of healthcare products.

1.1 Features and benefits

- Contactless measurement enables continuous, disturbance-free monitoring
- Reference design approach allows for wide integration options
- Low power consumption
- MEMS accelerometer with virtually unlimited lifetime
- Compatible with common manufacturing methods
- Easy to use Serial UART interface
- Outputs Beat to Beat times, allowing various HR and HRV metrics to be calculated

1.2 Target Applications

- Hospitals, elderly care, assisted living
- Heart Beat to Beat time detection
- Respiration rate detection
- Bed occupancy monitoring
- Sleep quality measurement
- Stress and relaxation analysis

2 Product codes

Table 1 Product codes

Part #	Description	Format	Minimum order quantity
BCGMCU-D01-PCB	PCB reference design sample	Sample bag	1 pc
BCGMCU-D01-004	BCGMCU sample component	Sample bag	4 pcs
BCGMCU-D01-1	BCGMCU for pre-production	Tape & reel	100 pcs
BCGMCU-D01-10	BCGMCU for mass production	Tape & reel	1000 pcs

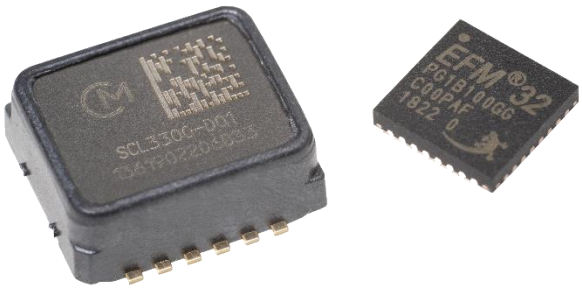

Figure 1 The SCL3300 inclinometer and the BCGMCU microcontroller (BCGMCU-D01-004,-1,-10)

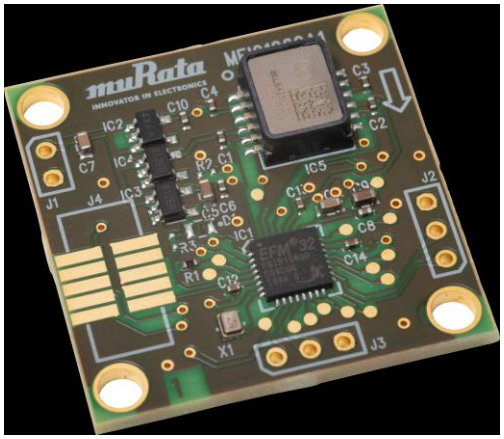

Figure 2 The BCGMCU-D01-PCB reference design sample

3 Product usage and specifications

The BCGMCU is intended for use with the SCL3300-D01 inclinometer, as a part of the BCG Reference Design. The “APP 5448 BCG Reference Design” application note describes an example PCB layout using the BCGMCU and the SCL3300, which can be used as a basis for product design.

The BCGMCU is a pre-programmed Silicon Labs EFM32PG1B100F256GM32 microcontroller, which offers a simple to use serial UART interface for use within the customer application. Product design should be done in accordance with the specifications of the EFM32PG series MCU:
https://www.silabs.com/products/mcu/32-bit/efm32-pearl-gecko

For electrical MCU specifications, please refer to the EFM32PG datasheet
https://www.silabs.com/documents/public/data-sheets/efm32pg1-datasheet.pdf

The SCL3300 is configured and interfaced by the pre-programmed application. The use of SCL3300 in customer products should be done in accordance to its product specification and other documentation that can be found here:
https://www.murata.com/en-sg/products/sensor/inclinometer/scl3300

The electrical characteristics can be found in the SCL3300 datasheet
https://www.murata.com/-/media/webrenewal/products/sensor/pdf/datasheet/datasheet_scl3300-d01.ashx?la=en-sg

SCL3300 assembly instructions are described here:
https://www.murata.com/-/media/webrenewal/products/sensor/pdf/assemblyinstruction/asse_infrastructiondflpkg_scl3300.ashx?la=en-sg

The subsections 3.1 and 3.2 describe the usage recommendations of the above components specific to their use in the BCG reference design.

3.1 BCGMCU specifications

The BCGMCU offers its application interface through a serial UART, and has a built in bootloader that is interfaced through a separate bootloader UART interface.

3.1.1 Main UART

SERIAL_RX/SERIAL_TX pins are the main UART communication pins of the BCGMCU.

Table 2 Serial port configuration for main UART

Parameter	
Baud rate	230400 baud
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Communication through this UART is described in the document “Product Specification 6169 BCGMCU binary protocol specification”.

3.1.2 Bootloader UART

The BOOTLOADER_RX/ BOOTLOADER_TX/ BTL_ENTRY pins are used for operating the bootloader of the BCGMCU. The RX and TX pins are used for serial communication, and the BTL_ENTRY pin is used for entering the bootloader upon MCU reset.

Table 3 Serial port configuration for bootloader UART

Parameter	
Baud rate	115200 baud
Data bits	8
Parity	None
Stop bits	1
Flow control	None

The bootloader operation is described in the document “Product Specification 5668 BCGMCU FW upgrade specification”.

3.1.3 LEUART (non-operational in BCGMCU_1.0.1.0)

LE_UART0_RX / LE_UART0_TX pins are reserved for possible future use within the application. These may be brought into use as an optional feature, where the BCGMCU can communicate its results through two serial channels simultaneously (for example acceleration data and BCG algorithm results at the same time).

The LEUART interface will operate at 9600 bauds if taken into use.

3.1.4 Pin description

Table 4 Pin description for the BCGMCU (EFM32PG1B100F256GM32)

Pin no	Name	Reference design pin	Description
1	PF0	SWCLK/BOOTLOADER_TX	Bootloader UART TX
2	PF1	SWDIO/BOOTLOADER_RX	Bootloader UART RX
3	PF2	BTL_ENTRY/BEP	Bootloader entry pin
4	PF3	TP3	Not in use
5	PF4	LED	Not in use
6	AVDD_1	D3V3	Analog power supply (3.3V)
7	HFXTAL_N	X1	40 MHz HF crystal N-pin
8	HFXTAL_P	X2	40 MHz HF crystal P-pin
9	RESETN	RESET	Hard reset pin
10	PD9	LE_UART0_TX	Not in use as of BCGMCU_1.0.1.0
11	PD10	LE_UART0_RX	Not in use as of BCGMCU_1.0.1.0
12	PD11	TP5	Not in use
13	PD12	TP6	Not in use
14	PD13	TP7	Not in use
15	PD14	TP8	Not in use
16	PD15	TP9	Not in use
17	PA0	SERIAL_TX	Application UART interface TX
18	PA1	SERIAL_RX	Application UART interface RX
19	PB11	TP12	Not in use
20	PB12	TP11	Not in use
21	PB13	TP10	Not in use
22	AVDD_0	D3V3	Analog power supply (3.3V)
23	PB14	LFXTAL_P	Not in use
24	PB15	LFXTAL_N	Not in use
25	DVDD	V_CORE	Core power supply (1.8V)
26	DECOUPLE	C11	1 µF/10 V decouple capacitor
27	IOVDD	D3V3	Digital IO power supply (3.3V)
28	PC7	MOSI (SCL3300)	SCL3300 SPI interface MOSI
29	PC8	MISO (SCL3300)	SCL3300 SPI interface MISO
30	PC9	SCK (SCL3300)	SCL3300 SPI interface SCK
31	PC10	TP13	Not in use
32	PC11	CSB (SCL3300)	SCL3300 SPI interface CSB
33	VSS	Ground	MCU ground (VREGVSS)

3.1.5 Block diagram of BCG reference design

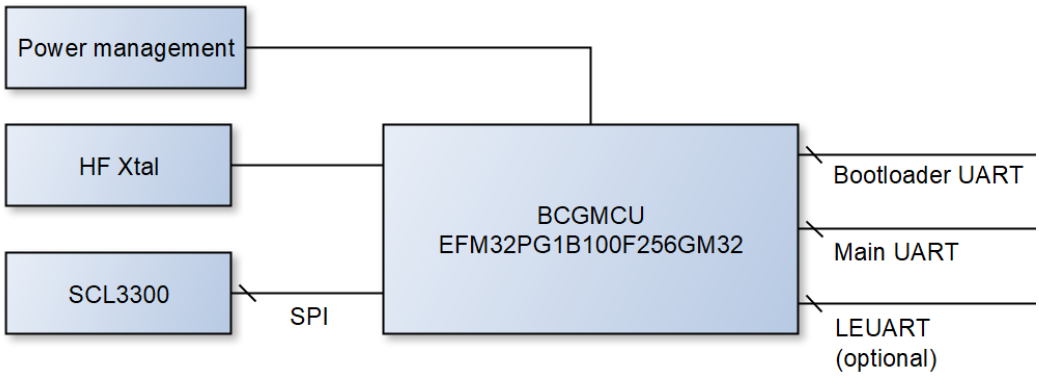

Figure 3 Block diagram of the BCGMCU reference design

3.1.6 BCGMCU current consumption in BCG operating modes

Table 5 Current consumption during operation

Operating mode	Current consumption
BCG mode	4.4 mA
Raw acceleration data	3.9 mA
2 channel raw acceleration data	5.9 mA

3.2 Use of SCL3300 with the BCGMCU

Only the Y-axis of the SCL3300 is used by the BCG algorithm. The product PCB should be designed so that the Y axis (see figures 3 and 4) points towards the head of the measurement subject when the device is placed on the bed.

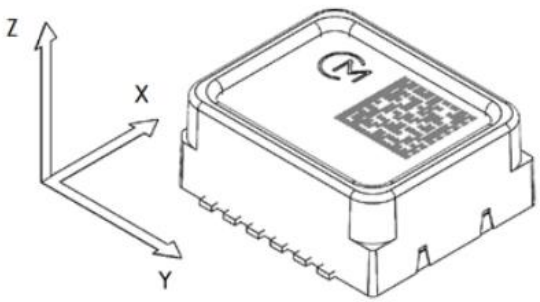

Figure 4 SCL3300 measurement axes

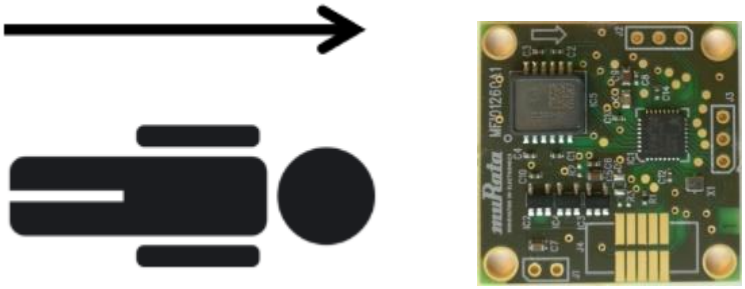

Figure 5 SCL3300 direction in measurement situation

The SCL3300 is used in its high resolution mode 4, and as stated in table 2 (Section 2.3) of the SCL3300 datasheet, the measurement range of the device is +/-10 degrees in this mode. It is thus not recommended to install the SCL3300 in such a location where the angle of Y-axis compared to horizon is above 10 degrees as this may result in saturation of the sensor output.

4 Functional specification

Table 6 Functional specification

Parameter	Min	Max	Unit
Pulse detection range	40	120	BPM

5 Communication

Binary protocol over UART (SERIAL_RX/SERIAL_TX) according to *Product Specification 6169 BCGMCU binary protocol specification*

For use in designs developed with the SCA10H product, a separate compatibility mode is available, in which SCA10H BCG Sensor_3.0.0.0 firmware version is replicated. Detailed description of this mode is available in the *Product Specification 6169 BCGMCU binary protocol specification* document.

6 Firmware upgrade

Firmware (FW) can be upgraded on the MCU through the bootloader UART interface. (BOOTLOADER_RX/BOOTLOADER_TX/BTL_ENTRY) according to *Product Specification 5668 BCG-MCU FW upgrade specification*.

7 Packaging

BCGMCU is provided pre-programmed and packaged on tape & reel.

7.1 Tape & Reel

The Tape & Reel package follows the EIA-481 E standard.

Reel diameter: 13 inch (33,02 cm)
Tape pitch: 8 mm
Tape width: 12 mm
Orientation: Dot in Q2
MCU dimensions: 5 x 5 x 0.85 mm
Quantity on reels: 100 pcs or 1000 pcs (BCGMCU-D01-1 and -10 respectively)

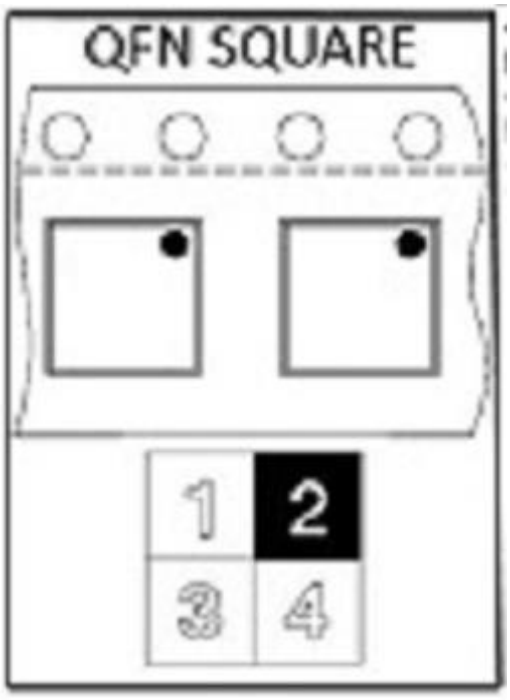

Figure 6 Orientation of MCU in pocket, direction of unreeling towards right

8 Note

Please make sure that our product BCGMCU has been evaluated and confirmed against your specifications. Please also note that our product BCGMCU has not been qualified for medical or similar use where it might directly or indirectly cause damage to the third party's life, body or property.

All the items and parameters in this product specification have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment agreed upon between you and us. You are requested not to use our product deviating from such agreement.

We consider it is not appropriate to include other terms and conditions for transaction warranty in your product specifications, drawings or other technical documents. Therefore, even if your original part of this product specification includes such terms and conditions as warranty clause, product liability clause, or intellectual property infringement liability clause, we are not able to accept such terms and conditions in our product specification unless they are based on the governmental regulation and we have agreed in a separate contract. We would like you to discuss them when negotiating the contract.

9 Change control

Rev.	Date	Change Description
1	12-Nov-19	1st version