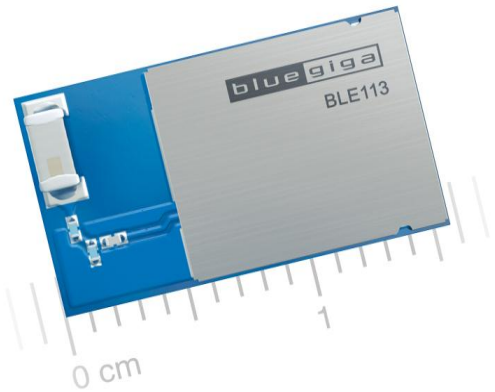




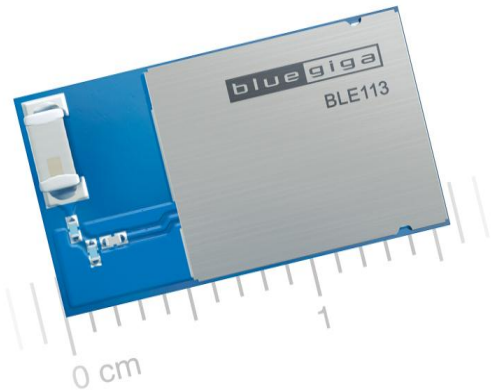
BLE113 *Bluetooth*® Smart Module

Table of Contents

- Key Features
- Benefits
- BLE113 Overview
- *Bluetooth* Smart Software
- Certifications
- Development Tools
- Use Cases

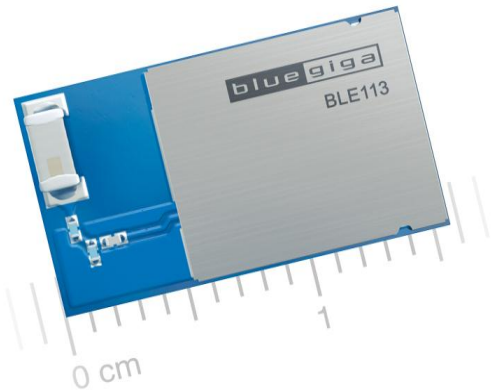


Key Features



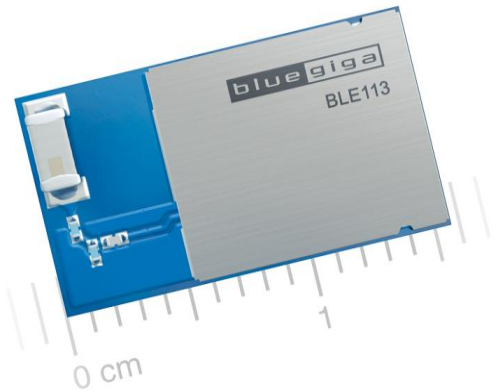
- **Bluetooth v.4.0, single mode compliant**
 - Supports master and slave modes
 - Up to 8 connections
- **Integrated Bluetooth Smart stack**
 - GAP, GATT, L2CAP and SMP
 - Bluetooth Smart profiles
- **Radio performance**
 - Transmit power : +0 dBm
 - Receiver sensitivity: -93dBm
- **Ultra low current consumption**
 - Transmit: 18 mA (0 dBm)
 - Sleep mode 3: 0.5 uA
- **Flexible peripheral interfaces**
 - UART or SPI
 - I2C
 - PWM, GPIO
 - 12-bit ADC
- **Host interfaces**
 - UART
- **Programmable 8051 processor for stand-alone operation**
- **Bluetooth, CE, FCC, IC, South-Korea and Japan qualified**

Benefits



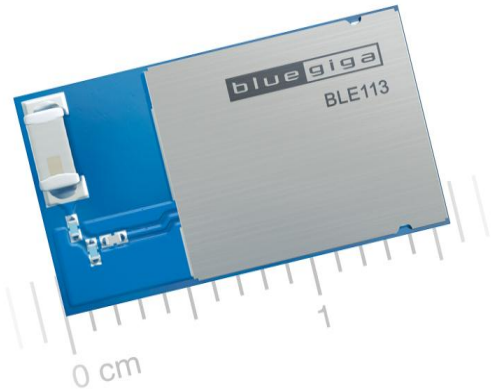
- **Fully integrated *Bluetooth* Smart solution**
 - Integrated *Bluetooth* Radio, micro controller and software stack
 - Fast time to market
 - Low development risks
- **Application hosting capabilities**
 - All application code can be executed on the BLE113
 - No need for external micro controller
 - Lower cost and smaller physical size
- **Flash based**
 - Firmware is field upgradable
 - Application data can be stored on the flash
 - Settings can be stored on the flash
- **Compact size:**
 - Dimensions: 15.75 x 9.15 x 2.1 mm
- ***Bluetooth*, CE, FCC, IC, Japan and South Korea qualified**
 - Proven interoperability
 - Minimal qualification costs

BLE113 Overview



- **Bluetooth low energy radio**
 - Frequency: 2402 – 2480 MHz
 - TX power: +0 dBm
 - RX sensitivity: -93 dBm
 - Modulation: GFSK
 - Symbol rate: 1 Mbps
- **Antenna**
 - Integrated ceramic chip
- **Typical line of sight range:**
 - +0 dbm: 100+ meters
 - -20 dBm: ~5 meters

BLE113 Overview



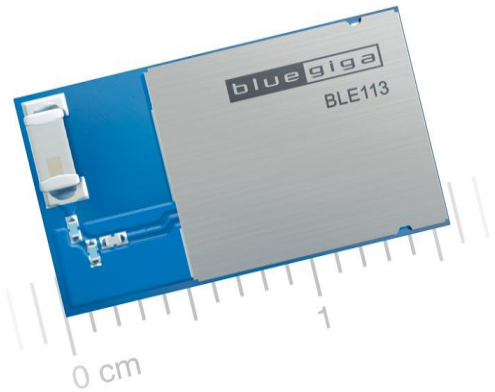
A total of 21 general purpose I/O pins

- **USART0**
 - SPI master/slave or UART 1Mbps
 - Hardware flow control
- **USART1**
 - SPI master/slave or UART 1Mbps
 - Hardware flow control
- **ADC**
 - 7 x ADC, 7-12-bit resolution
 - Internal temperature sensor
 - Internal battery monitor
- **I2C**
 - Low power, full speed I2C
- **GPIO**
 - Software programmable GPIO
- **PWM**
 - Up to 4 channel PWM

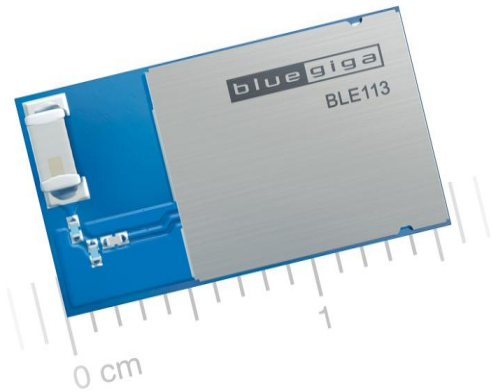
BLE113 Overview

A programmable 8051 microcontroller

- **Architecture**
 - 8-bit, 8051 architecture
- **SRAM**
 - 8 kB (3-4kB free)
- **Flash**
 - 128kB (40-50kB free)

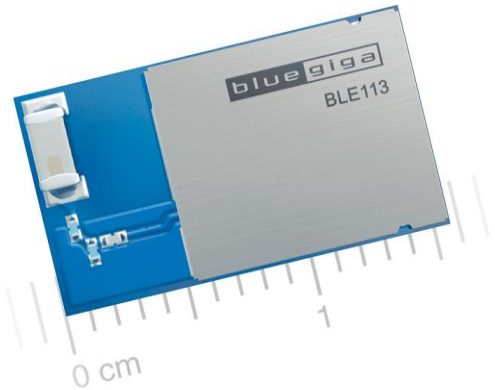


BLE113 Overview



- **Power supply and power consumption**
 - **General**
 - TX/RX can be as low as 14.7mA
 - Low MCU current consumption (~250uA/MHz)
 - Extremely low power sleep modes – as low as 0.5uA
 - **Optimized for coin cell CR2032**
 - Quick start-up – minimize duration of peak current consumption
 - Minimum operating voltage of 2.0 V provides good resistance to dips in voltage supply
 - Architecture allows 8051 core to operate independently from the radio keeping peak current as small as possible
 - **Good for alkaline as well**
 - Operating voltage range of 2.0 – 3.6 V matches dual AA

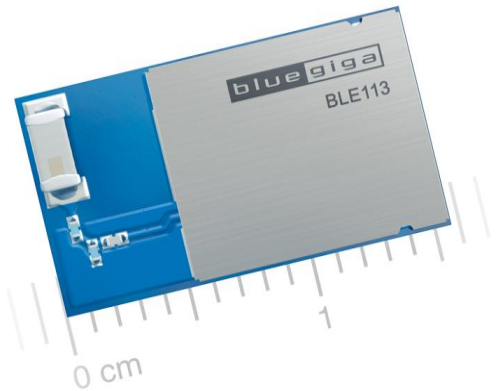
BLE113 Overview



BLE113 current consumption

- **TX peak**
 - 18.2 mA (0 dBm)
 - 14.3 mA (with DC/DC)
- **RX peak**
 - 17.9 mA
 - 14.7 mA (with DC/DC)
- **Sleep modes:**
 - 270 μ A (power mode 1)
 - 1 μ A (power mode 2)
 - 0.5 μ A (power mode 3)

BLE112 vs. BLE113



- **TX power**

BLE112	3 dBm
BLE113	0 dBm
- **Current consumption**

BLE112	30 mA (-2 dBm)
BLE113	18.2 mA (0 dBm)
- **Physical size**

BLE112	18 x 12 x 2.3 mm
BLE113	15.75 x 9.15 x 2.1 mm
- **Interfaces**

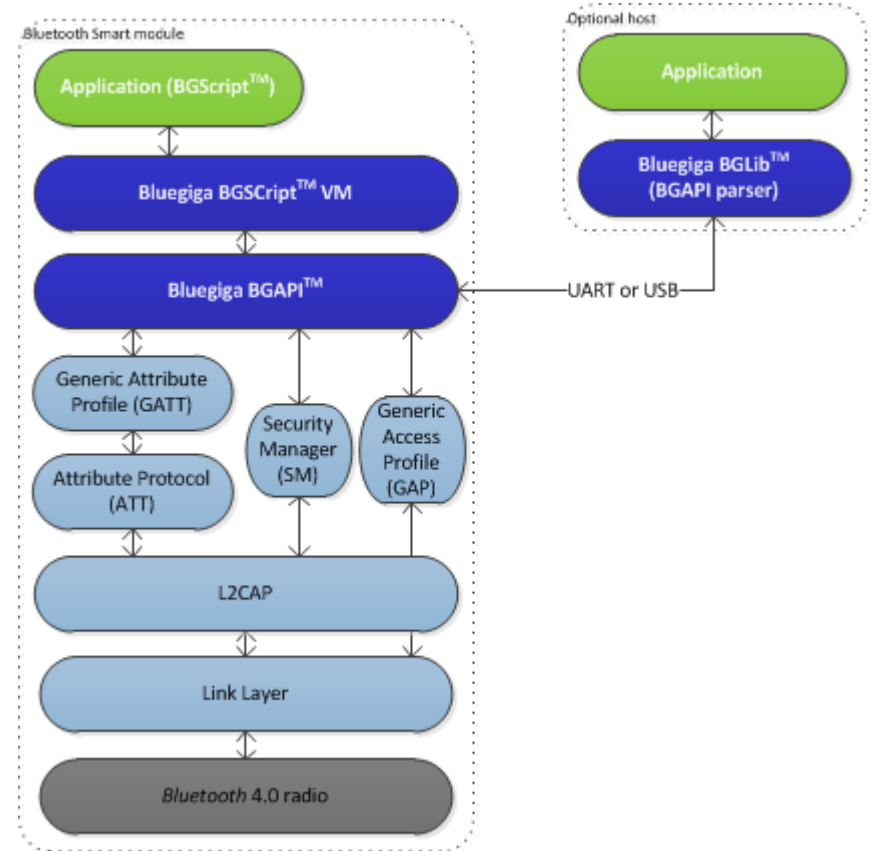
BLE113 lacks USB, but has a hardware I2C instead



Bluetooth® Smart Software

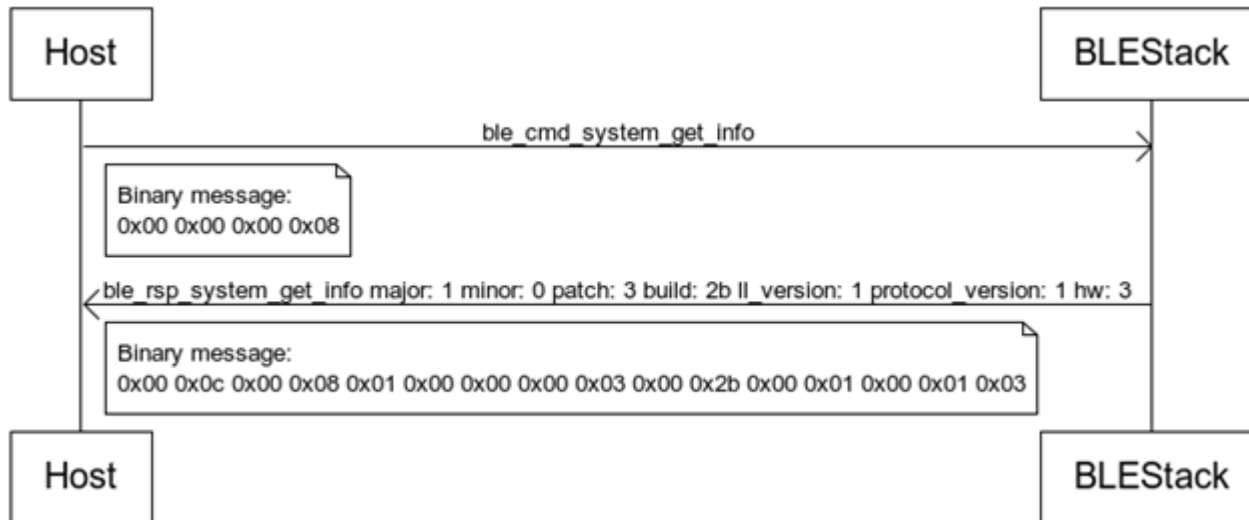
Bluetooth Smart Software

- **Bluetooth v.4.0, single mode compliant**
 - Supports master and slave modes
 - Up to 8 simultaneous connections
- **Implements all Bluetooth Smart functionality**
 - GAP, L2CAP, ATT, GATT
 - Security manager: bonding, encryption
 - Bluetooth Smart profiles
- **Simple API for external host processors**
 - BGAPI™ : A simple protocol over UART or USB interfaces
 - BGLib™ : A C library for host processors implementing BGAPI
- **Supports standalone applications as well**
 - BGScript™ : A simple scripting language for writing applications
 - **No separate host needed**
- **Bluetooth Smart Profile Toolkit™**
 - XML based development tool for Bluetooth Smart profiles
 - Fast and simple profile development
- **Small memory requirements**
 - ~4kB RAM
 - ~70kB flash (depending of used features/profiles)
- **Bluetooth qualified**



**Bluegiga Bluetooth®
Smart Software**

- **BGAPI™ protocol** : A simple binary command, response and event protocol between the host and the stack
 - Used when a separate host (MCU) is used to control BLE113 over UART or USB
 - Very small memory requirements size requirement and low implementation overhead



- **BGLib™ library** : A portable ANSI C library, which implements the BGAPI protocol
 - Easy to port to various architectures such as : ARM Cortex, PIC16/32 etc.
 - Uses function-call back architecture

C Functions

```
/* Function */
void ble_cmd_gap_connect_direct(
    bd_addr address ,
    uint8 addr_type ,
    uint16 conn_interval_min ,
    uint16 conn_interval_max ,
    uint16 timeout
);

/* Callback */
void ble_rsp_gap_connect_direct(
    uint16 result ,
    uint8 conn
);
```

- **BGScript™ scripting language** : A very simple BASIC-like application scripting language
 - Used when applications are implemented on the BLE113's 8051 controller
 - Enables very fast application development and allows programs to be executed directly on the BLE113 without the need of an external MCU

```
# System boot event listener : Executed when BLE112 is started
event system_boot(major ,minor ,patch ,build ,ll_version ,protocol_version ,hw )

    # Configure ADV interval to 1000ms and start advertisements an all channels
    call gap_set_adv_parameters(1600, 1600, 7)

    # Start generic advertisement and enable connections
    call gap_set_mode(2,2)

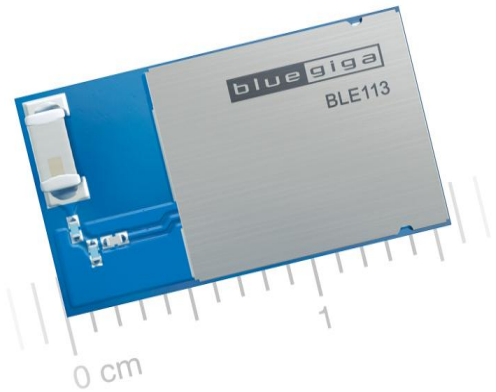
    #Start a continuous software timer, which generates interrupts every 1000ms
    call hardware_set_soft_timer(32768, 1, 0)
end
```

- **Why to use BGScript™?**
- **Very simple to use**
 - Fast development of simple *Bluetooth* Smart applications
 - Examples: Pairing, simple user interfaces, simple sensors
- **Free software development tools**
 - Code developed with any text or source code editor
 - Code compiled with Bluegiga's free compiler
- **Several example scripts available**
 - Heart Rate sensor
 - Proximity reporter
 - FindMe tag
 - Medical devices such as blood glucose
- **Cuts out the need for external MCU**
 - Reduced product eBoM
 - Smaller footprint
 - Faster time-to-market

- **Bluetooth Smart Profile Toolkit™**: A tool for creating *Bluetooth Smart* profiles
 - *Bluetooth Smart* profiles are very simple
 - Can be describes with a single file of XML
 - Profile toolkit is a Simple description language of *Bluetooth Smart Profiles*
- **Several example profiles and services available**
 - Heart Rate Sensor
 - Proximity Reporter
 - FindMe
 - Blood glucose

```
<?xml version="1.0" encoding="UTF-8" ?>
- <configuration>
+ <service>
- <service>
  <uuid>3a00</uuid>
  <description>Heartrate Service</description>
- <characteristic id="heartrate">
  - <properties>
    <read />
    <notify />
  </properties>
  <uuid>3a01</uuid>
  <value type="UINT8" />
  <description>Beats per minute</description>
</characteristic>
- <characteristic id="rr_interval">
+ <properties>
  <uuid>3a02</uuid>
  <value type="UINT16" />
  <description>R-R Interval</description>
</characteristic>
- <characteristic>
  <uuid>3a03</uuid>
+ <properties>
  <value type="SFLOAT" unit="kJ" />
  <description>Energy Expended</description>
</characteristic>
- <characteristic>
  <uuid>3a04</uuid>
+ <properties>
  <value type="UINT8" />
  <description>Sensor Status</description>
</characteristic>
+ <characteristic type="aggregate">
</service>
</configuration>
```

Certifications



- **Bluetooth 4.0**
 - BLE113: Controller subsystem
 - Software : Host subsystem
- **CE**
 - EN300328
 - EN301489-1/17
 - EN60950-1
- **FCC**
 - Part 15C modular approval
- **Industry Canada**
 - IC modular certification
- **South Korea**
 - KCC certification
- **Japan**
 - ARIB-STD-66

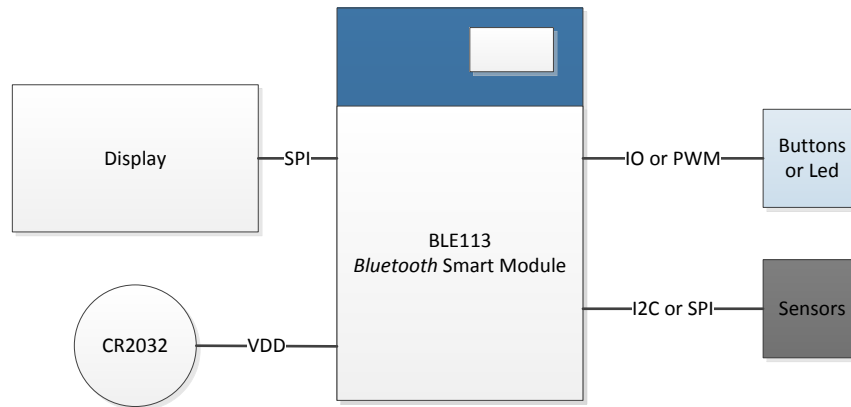


Development Tools



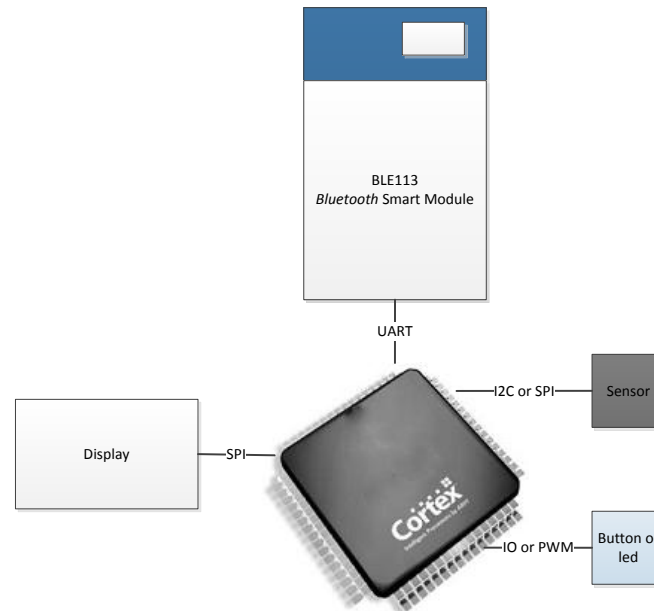
- **BLE113 Development Kit**
 - BLE113-A
 - Display
 - On-board accelerometer
 - On-board altimeter
 - Potentiometer
 - CR2032 battery holder
 - USB and RS232 interfaces
 - Programming interface
 - Current measurement point
 - External DC/DC converter
 - I/O headers
 - + Firmware programming tools
 - + BLED112 USB dongle
 - + 2 x BLE113-A modules
- **Bluetooth Smart SDK**
 - BGAPI™ documentation
 - BGScript™ development tools
 - BGLib™ source code
 - Profile Toolkit™
 - BGScript and BGLib examples
 - Profile examples
 - Documentation
 - iOS example applications

- **Standalone architecture:** No separate host processor
 - Sensors and peripherals are directly connected to the BLE113 via the IO interfaces
 - Application executed on the on-board 8051
 - Application developed with BGScript™ and services and profiles with Profile Toolkit™



Applications: sport and fitness, medical and health care, smart energy, home automation, security, proximity and presence etc.

- **Hosted architecture:** A separate MCU is used
 - Sensors and peripherals are directly connected to the MCU via the IO interfaces
 - BLE113 connected to the MCU via UART or USB
 - Application developed to the MCU and interfacing to BLE113 done using BGAPI™ protocol (BGLib™ can be used on the host)
 - Profile developed with Profile Toolkit™





Thank You

