UPCOMING SESSIONS

FEB 23RD | ML in Predictive Maintenance and Safety Applications
MAR 23RD | Unboxing: What’s New With Bluetooth
APR 20TH | What’s New with Bluetooth Mesh 1.1
MAY 18TH | Bluetooth Portfolio: What’s Right for Your Application
JUN 15TH | The Latest in HADM With Bluetooth LE
Agenda

- xG27 Introduction
- xG27 Differentiating Features
- Development Hardware and Software
- GitHub Demo
- Simplicity Studio Demo
- Summary and Q&A
EFR32BG27 and EFR32MG27 Target Applications

- **Connected Health**
  - Portable Medical Devices
    - Continuous glucose monitors, pulse oximeters, medical patches, electrocardiograms
  - Clinical Medical Devices
  - Wearables

- **Smart Home**
  - Sensors, Switches
  - Door Locks
  - HVAC, Thermostats
  - LED Lighting
  - Small Appliances

- **Industrial and Commercial**
  - Building Automation
  - Commercial Lighting
  - Access Control
  - Asset Tracking, Indoor RTLS
# xG27: Most Battery Versatile Series-2 SoC

## DEVICE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
</table>
| **High Performance 2.4 GHz Radio** | - Up to +8 dBm TX  
- -98.9 dBm RX @ BLE 1 Mbps  
- -106.7 dBm RX @ BLE 125 kbps |
| **MCU Core**                  | ARM Cortex®-M33 (76.8 MHz with FPU & DSP)                                |
| **Memory**                    | - Up to 64kB RAM  
- Up to 768kB Flash                                                      |
| **Ultra Low Power**           | - 1.1 µA EM2 with 8 kB RAM retention  
- 4.1 mA TX @ 0 dBm  
- 3.6 mA RX (BLE 1 Mbps)                                                 |
| **Multiple protocol support** | - Bluetooth 5.3 (1M/2M/LR), Bluetooth mesh  
- Zigbee 3.0  
- Proprietary 2.4 GHz                                                     |
| **Feature Rich peripherals**  | - 16-bit ADC, USARTs, I2C, I2S, PDM, Timers                             |
| **Package**                   | - 2.3x2.6 WLCSP (19 GPIO) +85°C  
- 4x4 QFN32 (18 GPIO) +125°C  
- 5x5 QFN40 (26 GPIO) +125°C                                              |

## DIFFERENTIATED FEATURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Extremely small form-factor</strong></td>
<td>2.3 x 2.6 WLCSP package⁴</td>
</tr>
</tbody>
</table>
| **Flexible battery support**     | - DCDC Buck/Boost  
- Supports 1.7 to 3.6 volts  
- Supports 0.8 to 1.7 volts |
| **Enhanced security**            | - Secure Vault™ Mid  
- Tamper detect  
- Customer Key Management w/PUF                                       |
| **Battery management**           | - Coulomb counter                                                       |
| **Wake-up pin (BOOST_EN)**       | - Enables <20 nA for long-term storage                                  |
|                                  | - Up to 10 years of shelf storage                                       |
Differentiating Features
Boost DC-DC Converter

- **Input range:** 0.8 V to ~1.7 V
  - Adds support for lower voltage batteries
  - Silver Oxide: ~1.2 to 1.65 V
  - Alkaline / Rechargeable AA/AAA form: ~0.9 to 1.5 V
- **Coulomb counter**
  - Enables accurate battery level tracking
- **Shelf mode with a wake-up pin**
## Secure Vault™ - Protecting the IoT Device

<table>
<thead>
<tr>
<th>Feature</th>
<th>Base</th>
<th>Mid</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Random Number Generator</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Crypto Engine</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Secure Application Boot</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Secure Engine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure Boot with RTSL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure Debug with Lock/Unlock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPA Countermeasures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-Tamper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PUF Support (Seed Key to AES)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anti-Tamper</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Secure Attestation</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Secure Key Management</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Advanced Crypto</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

- **EFR32BG27**
- **EFR32MG27**

### Designing Secure IoT Devices

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Enhanced Security – DPA Countermeasures

**Vulnerabilities**
- Observing subtle differences during given internal operations can provide insight into cryptographic functions

**DPA Countermeasures**
- Countermeasures add masks and random timings to internal operations and distorts DPA snooping

A Differential Power Analysis (DPA) attack requires hands-on access to the device.

Monitoring electromagnetic radiation and fluctuations in power consumption during crypto operations may reveal security keys and other data.
E-Tamper

1. Tamper Pins on Case
   - Square wave out one pin and in another – broken signal can be fed into other logic to take tamper action

2. Tamper Trace Around Comms Link
   - Uses Cases:
     1) Connect Tamper Pins on a product case and then do trigger action when case opened
     2) Create Wire trace around bus in PC Board to protect communications between two components
     3) Power a tamper shield which can protect several components on a PCB

3. Purpose Built Tamper Shields
Enhanced Security - Customer Key Management with PUF

Wrapped Keys in Memory
- Wrapped Keys
- Wrapped Keys
- Wrapped Keys
- Wrapped Keys

Off-Chip Memory
- Wrapped Keys
- Wrapped Keys
- Wrapped Keys
- Wrapped Keys

AES Engine

Customer code

PUF
- Reconstruction Data
- PUF Key Unique Digital Signature

Customer written tamper code

Erase

Reset

Interrupt

Miscellaneous

Tamper
Example of **Tiny Medical Device Design** – Continuous Glucose Monitor

- **BG27 SoC Based**

- **Highlights**
  - BG27 CSP Package / Size
  - DCDC Buck/Boost
  - Power Optimization
    - Low active and sleep current
    - Shelf Mode (BOOST_EN)
  - Secure Vault
    - E-Tamper
  - Analog/Serial Peripherals
    - 16-bit ADC
  - CGM Sample Application
### Silicon Labs’ 2.4GHz SoC Portfolio

<table>
<thead>
<tr>
<th>Protocols</th>
<th>xG21</th>
<th>xG22</th>
<th>xG24</th>
<th>xG27</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Bands</strong></td>
<td>2.4 GHz</td>
<td>2.4 GHz</td>
<td>2.4 GHz</td>
<td>2.4 GHz</td>
</tr>
<tr>
<td><strong>Core</strong></td>
<td>Cortex-M33 (80 MHz) Cortex-M0+ (Security)</td>
<td>Cortex-M33 (76.8 MHz) Cortex-M0+ (Radio)</td>
<td>Cortex-M33 (78 MHz) Cortex-M0+ (Radio) Cortex-M0+ (Security)</td>
<td>Cortex-M33 (76.8 MHz) Cortex-M0+ (Radio)</td>
</tr>
<tr>
<td><strong>Max Flash</strong></td>
<td>1024 kB</td>
<td>512 kB</td>
<td>1536 kB</td>
<td>768 kB</td>
</tr>
<tr>
<td><strong>Max RAM</strong></td>
<td>96 kB</td>
<td>32 kB</td>
<td>256 kB</td>
<td>64 kB</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td>Secure Vault Mid Secure Vault High</td>
<td>Secure Vault Mid</td>
<td>Secure Vault Mid Secure Vault High</td>
<td>Secure Vault Mid</td>
</tr>
<tr>
<td><strong>Rx Sensitivity (15.4)</strong></td>
<td>-104.5 dBm</td>
<td>-102.3 dBm</td>
<td>-105.4 dBm</td>
<td>-102.3 dBm</td>
</tr>
<tr>
<td><strong>Rx Sensitivity (BLE 1Mbps)</strong></td>
<td>-97.5 dBm</td>
<td>-98.9 dBm</td>
<td>-97.6 dBm</td>
<td>-98.9 dBm</td>
</tr>
<tr>
<td><strong>Active Current</strong></td>
<td>63.8 µA/MHz</td>
<td>26 µA/MHz</td>
<td>33.4 µA/MHz</td>
<td>29 µA/MHz</td>
</tr>
<tr>
<td><strong>Sleep Current (EM2, 16 kB ret)</strong></td>
<td>4.5 µA</td>
<td>1.2 µA (8 kB)</td>
<td>1.3 µA</td>
<td>1.6 µA (64 kB)</td>
</tr>
<tr>
<td><strong>TX Current @ +0 dBm (2.4 GHz)</strong></td>
<td>9.3 mA</td>
<td>4.1 mA</td>
<td>5.0 mA</td>
<td>4.1 mA</td>
</tr>
<tr>
<td><strong>TX Current @ +10 dBm (2.4 GHz)</strong></td>
<td>33.8 mA</td>
<td>8.2 mA @ +6 dBm</td>
<td>19.1 mA</td>
<td>11.3 mA @ +8 dBm</td>
</tr>
<tr>
<td><strong>TX Current @ +20 dBm (2.4 GHz)</strong></td>
<td>185 mA</td>
<td>N/A</td>
<td>156.8 mA</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>RX Current (802.15.4)</strong></td>
<td>9.4 mA</td>
<td>3.9 mA</td>
<td>5.1 mA</td>
<td>3.9 mA</td>
</tr>
<tr>
<td><strong>RX Current (BLE 1 Mbps)</strong></td>
<td>8.8 mA</td>
<td>3.6 mA</td>
<td>4.4 mA</td>
<td>3.6 mA</td>
</tr>
<tr>
<td><strong>Serial Peripherals</strong></td>
<td>USART, I2C</td>
<td>USART, EUSART, I2C, PDM</td>
<td>USART, EUSART, I2C, I2S, PDM</td>
<td>USART, EUSART, I2C, I2S, PDM</td>
</tr>
<tr>
<td><strong>Analog Peripherals</strong></td>
<td>12-bit ADC, ACMP</td>
<td>16-bit ADC</td>
<td>20-bit ADC, ACMP, VDAC</td>
<td>16-bit ADC, ACMP, Coulomb Counter</td>
</tr>
<tr>
<td><strong>Die Temp Sensor</strong></td>
<td>1.71 V to 3.8 V</td>
<td>1.71 V to 3.8 V</td>
<td>1.71 V to 3.8 V</td>
<td>0.8 – 1.6 V</td>
</tr>
<tr>
<td><strong>GPIO</strong></td>
<td>20</td>
<td>18, 26</td>
<td>26, 28/32</td>
<td>26, 18, 19</td>
</tr>
<tr>
<td><strong>Package</strong></td>
<td>4x4 QFN32</td>
<td>4x4 TQFN32</td>
<td>5x5 QFN40</td>
<td>5x5 QFN40</td>
</tr>
<tr>
<td></td>
<td>4x4 TQFN32</td>
<td>5x5 QFN40</td>
<td>6x6 QFN48</td>
<td>4x4 QFN32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.3x2.6 WLCSP</td>
</tr>
</tbody>
</table>
Development Hardware & Software Overview

Tim Sams
Getting Started with EFR32BG27 and EFR32MG27 SoCs

- **Dev Board**
  - Low-cost development board
  - On-board debugger
  - Signal breakouts
  - On-board sensors
  - 16-bit ADC

- **Contents**
  - 1x dev board

- **Pro kits**
  - Modular development platform
  - Advanced development
  - RF measurements
  - Energy profiling
  - External device debug
  - Ethernet for large network test

- **Contents**
  - 1 x WSTK main board
  - 1 x radio board

- **Radio Board kits**
  - Uses existing WSTK boards
  - Uses existing software tools

- **Contents**
  - 1x radio board

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>xG27-DK2602A</td>
<td>EFR32xG27 2.4 GHz +8 dBm dev board</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>xG27-PK6017A</td>
<td>EFR32xG27 2.4 GHz +8 dBm Pro Kit (Buck)</td>
</tr>
<tr>
<td>xG27-PK6018A</td>
<td>EFR32xG27 2.4 GHz +4 dBm Pro Kit (Buck)</td>
</tr>
<tr>
<td>xG27-PK6019A</td>
<td>EFR32xG27 2.4 GHz +4 dBm Pro Kit (Boost)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>xG27-RB4194A</td>
<td>EFR32xG27 2.4 GHz +8 dBm Radio Board (Buck)</td>
</tr>
<tr>
<td>xG27-RB4110B</td>
<td>EFR32xG27 2.4 GHz +4 dBm Radio Board (Buck)</td>
</tr>
<tr>
<td>xG27-RB4111B</td>
<td>EFR32xG27 2.4 GHz +4 dBm Radio Board (Boost)</td>
</tr>
</tbody>
</table>
Dev Board Features

- **Features**
  - EFR32BG27C140F768IM40 for +8 dBm Kit (Buck)
  - Wireless SoC with multi-protocol radio
  - Cortex-M33, 768 kB Flash and 64 kB RAM
  - Coulomb counter

- **Broad Range of Sensors**
  - 9-axis Inertial Sensor
  - 2 Digital Microphones
  - Pressure Sensor
  - Relative Humidity and Temperature Sensor
  - UV and Ambient Light Sensor
  - Hall-effect Sensor

- **Expansion and User Interface**
  - Breakout pads
  - Qwiic connector
  - LEDs and Push Buttons
Radio Board and Main Board Features

Radio Board Features
- EFR32MG27C140F768IM40 for +8 dBm Kit (Buck)
- EFR32BG27C320F768GJ39 for +4 dBm Kit (Buck)
- EFR32BG27C320F768GJ39 for +4 dBm Kit (Boost)
- Cortex-M33, 768 kB Flash and 64 kB RAM
- Secure Vault Mid
- U.FL for RF Measurements

Main Board Features
- LEDs and Push Buttons
- Ethernet and USB connectivity
- Advanced Energy Monitor
- Packet Trace Interface
- Breakout pads and expansion header
- External debug support
- Si7021 Relative Humidity and Temperature sensor
- Low Power 128x128 pixel Memory LCD
- USB, CR2032, and battery pack options for power
Github Demo
Simplicity Studio 5

• Interface
  ▶ Fresh, new & simplified
  ▶ Intuitive out-of-the-box experience
  ▶ Fast access to developer resources
  ▶ Linux, Mac & Windows

• Tools
  ▶ Configuration utilities
  ▶ Compiler
  ▶ Error & validation
  ▶ IDE & command line support
  ▶ Graphical hardware configurator
  ▶ Energy Profiler – visual energy analysis
  ▶ Network Analyzer – packet capture & decode
EFR Connect combines the smoothest out of box experience with the most advanced developer features for BLE, in a single mobile app.

Main Navigation Bar w/ distinct purpose views
- **Demo**: Ready-to-go demos with a matching sample app on GSDK pre-compiled for numerous kits
- **Scan**: for searching, connecting and interacting with remote devices
- **Configure**: Local Advertise and GATT Configurator for mobile phone
- **Test**: (IOP) to assess behavior against Silicon Labs’ Bluetooth SW and HW
- **Settings**: For System configuration and app information
xG27 and Simplicity Studio Demonstration
Summary
BG27 and MG27: Smallest, and most battery versatile SoCs for the Edge

- Smaller devices without compromising power, performance, or security
  - Ultra-compact 2.3mm x 2.6mm WLCSP package
  - DCDC Buck/Boost allowing operation down to 0.8 volts
  - Secure Vault™ Mid
    - Tamper detect
    - Secure Key Management w/PUF
  - 16-Bit ADC for highly accurate analog sensing

- Worry-free battery-life expectancy
  - Coulomb counter for enhanced battery monitoring

- Reliable Wireless
  - Multiprotocol 2.4 GHz wireless SoC with High-Performance RF
    - Bluetooth, Bluetooth mesh, and Zigbee

- Unleash Your Innovation and Extend your Product Lifetime!
  - Enough memory facilitating more features and OTA updates
Resources and Links

BG27 Web Page
- https://www.silabs.com/bg27

MG27 Web Page
- https://www.silabs.com/mg27

Studio 5
- https://www.silabs.com/developers/simplicity-studio

EFR Connect
- https://www.silabs.com/developers/efr-connect-mobile-app

GitHub
- https://github.com/siliconlabs
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Thank You

Watch ON DEMAND
Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Silicon Laboratories:

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