

Silicon Labs Bluetooth

Silicon Labs Bluetooth Training


November 2022



What do we have?




The Leader in IoT Wireless Connectivity



100%
IoT Focused

Bluetooth® Multiprotocol Proprietary
 ̸HREAD WiFi WISUN zigbee
 ZWAVE amazon sidewalk matter
 Breadth and Depth of Wireless IoT Protocols



#1
Share in Mesh



1st
To Market with Multiprotocol, BLE Mesh, BLE 5.1



Innovation
Performance, Power, CoEx, Modules, Secure Vault™

ember
2012
Software ZigBee SoC

ENERGY
micro
2013
Low-power 32-bit MCUs

bluegiga
2015
BT Smart Modules

telegesis
2015
ZigBee/Thread Modules

Micrium
2016
Software RTOS

ZENTRI
2017
Cloud Connected Wi-Fi

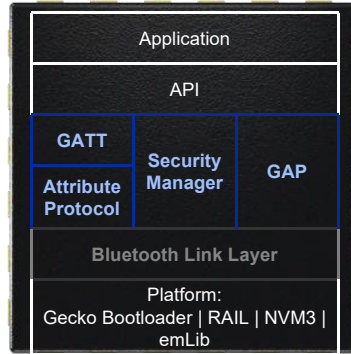
ZWAVE
2018
Smart Home Protocol

REDPINE SIGNALS
2020
Ultra Low Power Wi-Fi

Silicon Labs' Series 2 Wireless SoC Comparison

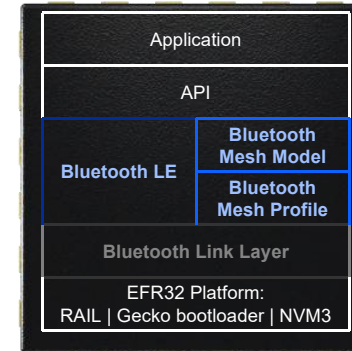
	BG21, MG21	BG22 FG22, BG22	FG23, ZG23	BG24, MG24	FG25	BG27, MG27
Description	2.4 GHz	2.4 GHz	Sub-GHz SoC	2.4 GHz	Sub-GHz	2.4 GHz
Support Protocols						
Core	M33 (80 MHz)	M33 (76.8 MHz)	M33 (78 MHz)	M33 (78 MHz)	Cortex-M33 (97.5 MHz)	M33 (76.8 MHz)
Max Flash	1024 kB	512 kB	512 kB	1536 kB	1920 kB	768 kB
Max RAM	96 kB	32 kB	64 kB	256 kB	512 kB	64 kB
Security	Secure Vault - Mid Secure Vault- High	Secure Vault – Mid	Secure Vault - Mid Secure Vault - High	Secure Vault - Mid Secure Vault – High	Secure Vault - Mid Secure Vault – High	Secure Vault – Mid
RX Sensitivity 802.15.4 (2.4 GHz)	-104.5 dBm	-102.3 dBm	N/A	-105.4 dBm	NA	-102.3 dBm
RX Sensitivity (BLE 1Mbps)	-97.5 dBm	-98.9 dBm	N/A	-97.6 dBm	N/A	-98.9 dBm
Sub-GHz (50 kbps 915 MHz)	N/A	N/A	-110.1 dBm	N/A	-110 dBm (100 kbps)	N/A
Active Current	63.8 µA/MHz	27 µA/MHz	26 µA/MHz	33.4 µA/MHz	50 µA/MHz	27 µA/MHz
Sleep Current (EM2, 16 kB ret)	4.5 µA	1.2 µA (8 kB)	1.2 µA	1.3 µA	3 µA	1.2 µA (8 kB)
TX Current @ +10 dBm (2.4 GHz)	33.8 mA	8.2 mA (+6 dBm)	N/A	19.1 mA	N/A	10.6 mA (+8 dBm)
TX Current @ +14 dBm (915 MHz)	33.8 mA	N/A	25 mA	N/A	59 mA	N/A
RX Current (2.4 GHz 802.15.4)	9.4 mA	3.9 mA	N/A	5.1 mA	N/A	4.0 mA
RX Current (2.4 GHz BLE 1Mbps)	8.8 mA	3.6 mA	N/A	4.4 mA	N/A	3.6 mA
RX Current (915 MHz GFSK)	N/A	N/A	4.3 mA (50 kbps)	N/A	6.2	N/A
Serial Peripherals	USART, I2C	USART, EUART, I2C	USART, EUSART, I2C	USART, EUSART, I2C	EUSART, I2C, USB	USART, EUART, I2C
Analog Peripherals	12-bit ADC, ACMP,	16-bit ADC	16-bit ADC, ACMP, VDAC, LCD	20-bit ADC, ACMP, VDAC	16-bit ADC, ACMP, VDAC	16-bit ADC, ACMP
Other Peripherals		PDM, Temp Sensor PLFRCO	LESENSE, PCNT, Temp Sensor	Temp Sensor, PLFRCO	LESENSE, PCNT, Temp Sensor	PDM, Temp Sensor PLFRCO, Coulomb Counter
Operating Voltage	1.71 V to 3.8 V	1.71 V to 3.8 V	1.71 V to 3.8 V	1.71 V to 3.8 V	1.71 V to 3.8 V	0.8V to 1.6V 1.71 V to 3.8 V
Operating Conditions	3.0V no DCDC	3.0V DCDC	3.3V DCDC	3.0V DCDC	3.6V DCDC	3.0V DCDC
Package	4x4 QFN32	4x4 QFN32 4x4 TQFN32 5x5 QFN40	5x5 QFN40 6x6 QFN48	5x5 QFN40 6x6 QFN48	7x7 QFN56	2.5x2.5 WLCSP 4x4 QFN32 5x5 QFN40

Bluetooth LE and Bluetooth mesh Software



V5.3 Qualified Stack with advanced functionality

- Multiple connections and advertisers
- Concurrent advertising, scanning and LE connections
- Optimized throughput and power consumption



v1.0 Qualified Mesh Profile & Models

- Support for all roles
- Large network support and low latency.
- Generic, Lighting, Sensor and Vendor specific models

Built on top of the common EFR32 software platform

- Secure boot
- emLib for MCU peripherals and drivers
- NVM3 key/value pair data storage with wear leveling
- RAIL radio driver

Tested for reliability and interoperability

- Automated QA testing
- Automated Interop testing with mobile apps

Why Silicon Labs Bluetooth?



Bluetooth LE – Performance Figures



Feature	Value
Simultaneous connections	Up to 8 (BG1 and BG22) or 16 (xG12 and xG13, BG21)
Throughput (EFR32-2-EFR32)	1M PHY: ~700kbps 2M PHY: ~1300kbps 125k PHY: ~100kbps
Packets per connection interval	Not limited
Link Layer packet size	Up to 251B
ADV payload size	Up to 191B (per packet)
ATT MTU	Up to 250B
RF	Up to 20dbm TX Power, -98.9dbm Sensitivity

Securing Bluetooth Products with BG22



Hardware Accelerated Crypto

- Faster, more energy efficient and secure than software

True Random Number Generator (TRNG)

- Compliant with NIST SP800-90 and AIS-31

Secure Boot with Root of Trust and Secure Loader (RTSL)

- Prevents malware injection and rollback
- Ensures authentic firmware execution and OTA updates

Secure Debug with Lock/Unlock

- Allows authenticated access for enhanced Failure Analysis (FA)

ARM Cortex M33 Core with TrustZone

- Provides cost effective hardware isolation

www.silabs.com/security

Extending Battery Life in Bluetooth Applications



Data Transfer

Connected to a phone at 2000ms interval

Using 2M PHY and transmitting 10 Byte / packet

Average current: 4.2 μ A



Location Services

Advertising 10 bytes every 1000ms

TX at 0dBm and using 1 channel

Average current: 3.7 μ A

5+ years on CR2032
10+ years on a CR2354

It's More Than Just a Bluetooth Stack...



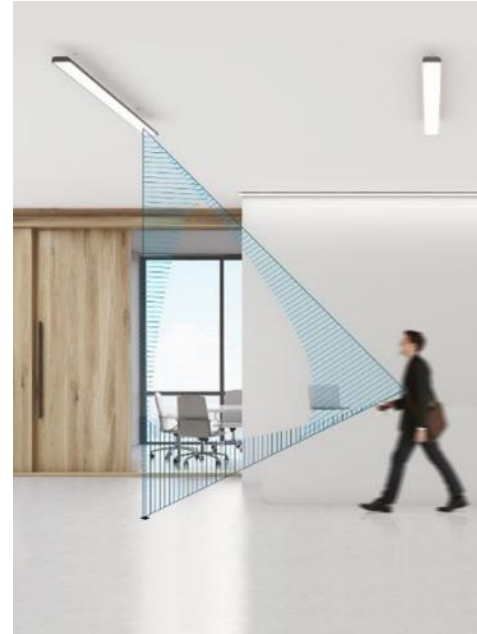
**BEST IN CLASS
SECURITY**

Secure Vault™
technology protects the
device from local and
remote cyber attacks



**FLEXIBLE SOFTWARE
ARCHITECTURE**

Run everything on a the
EFR32 or use the EFR32
as a Bluetooth co-
processor with a
separate host processor



**HIGH PERFORMANCE
RF**

Best in class sensitivity
and up to +20 dBm
options ensure robust
and reliable
communication



WI-FI CO-EXISTENCE

Wi-Fi co-ex scheme
significantly improves
performance
in co-located radio
designs

Where Do We Play



Bluetooth Solution Areas



LOCATION SERVICES

2022 Market Shipments

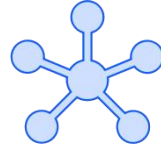
- 252 million (25% CAGR)
- Presence, distance, direction

Use Cases

- Item Finding
- Asset Tracking
- Access Control

Sample Devices

- Asset Tags
- Beacons
- Locators
- Access Controls
- Smart Speakers
- Power



DEVICE NETWORKS

2022 Market Shipments

- 616 million (20% CAGR)
- Bluetooth mesh

Use Cases

- Automation Systems
- Control Systems
- Monitoring Systems

Sample Devices

- Lighting
- Sensors (lighting, temp, etc)
- Control
- HVAC
- Access Control



DATA TRANSFER

2022 Market Shipments

- 1 billion (12% CAGR)
- 35% IOT devices rely on BT

Use Cases

- Sports & Fitness
- Health & Wellness
- Input & Control

Sample Devices

- Fitness & smartwatches
- Portable Medical Devices
- PC Peripherals
- Small Appliances
- Power Tools
- Access Points



AUDIO STREAMING

2022 Market Shipments

- 1.4 billion (7% CAGR)
- Bluetooth Classic today

Use Cases

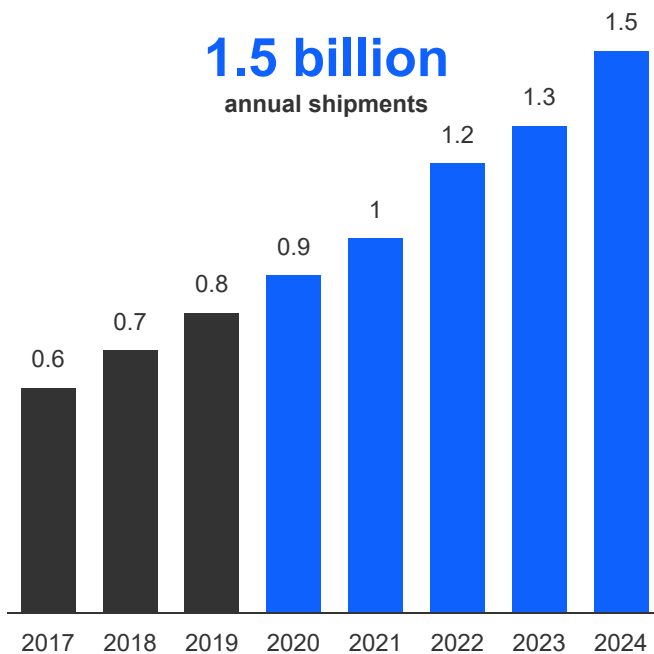
- Calling
- Listening
- Watching

Sample Devices (LE Audio)

- Smart Watches
- Headphones
- Hearing Aids
- TVs

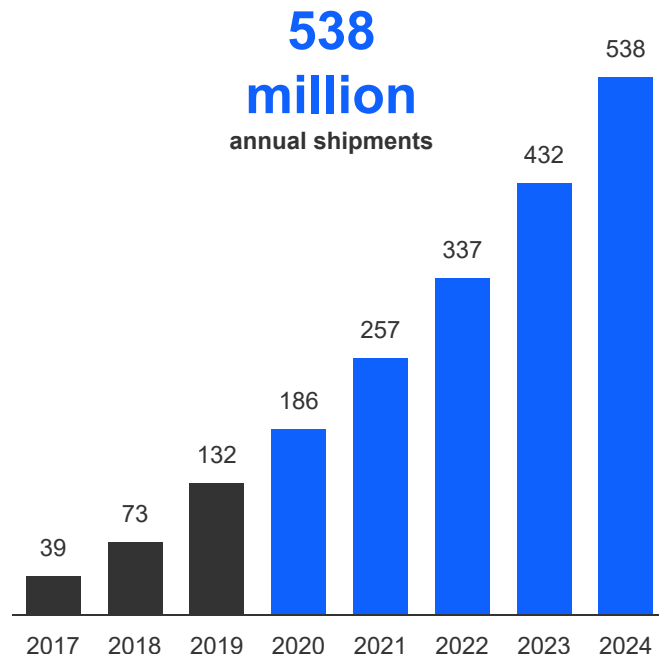
The Bluetooth LE Opportunity

DATA TRANSFER



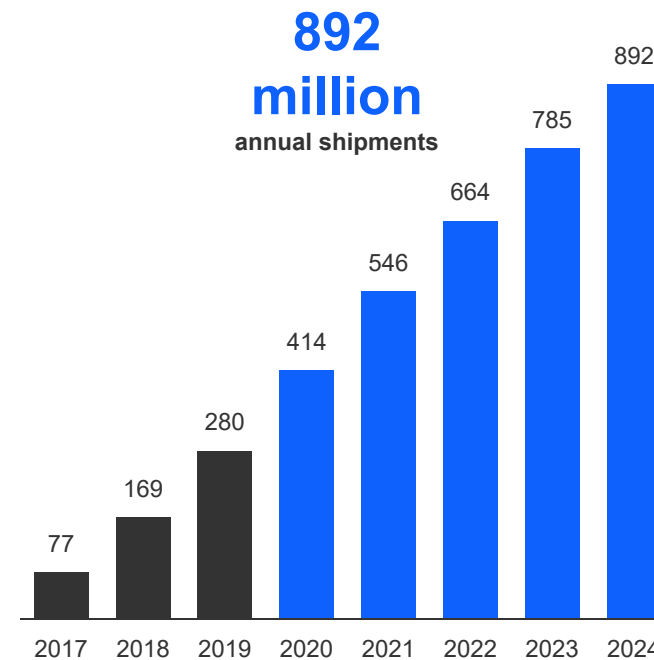
13% CAGR
2019 – 2024

LOCATION SERVICES



32% CAGR
2019 – 2024

MESH NETWORKING



26% CAGR
2019 – 2024

Advanced RF | Fast data transfer | High-volume optimized | 10-year battery life | Sub-meter accuracy | Secure

H&L Bluetooth Target Markets/Applications and Recommended Solutions

		Protocol	BG21	BGM210L	BGM210P	BG22	BGM220P	BGM220S	BG24	BGM240S	BGM240P	RS9116	RS9116W	
Smart Home	Appliances	Bluetooth LE				✓	✓	✓	✓	✓	✓		✓	
	Cameras	Bluetooth LE				✓	✓	✓						
	Door Locks	Bluetooth LE	✓			✓	✓	✓	✓	✓	✓		✓	
	Sensors	Bluetooth LE	✓			✓			✓					
		Bluetooth mesh	✓			✓			✓					
	Switches	Bluetooth LE	✓			✓		✓	✓	✓				
		Bluetooth mesh	✓			✓		✓	✓					
	LED Lighting	Bluetooth LE	✓	✓					✓					
		Bluetooth mesh	✓	✓					✓					
Hubs & Panels	Bluetooth LE	✓			✓									
HVAC	Bluetooth LE	✓			✓	✓	✓	✓	✓	✓				
Connected Health	Wearables	Bluetooth Classic/ Audio										✓	✓	
		Bluetooth LE				✓	✓	✓	✓	✓	✓			
	Portable Medical	Bluetooth LE	✓			✓	✓	✓	✓	✓	✓			

I&C Bluetooth Target Markets/Applications and Recommended Solutions

		Protocol	BG21	BGM210L	BGM210P	BG22	BGM220P	BGM220S	BG24	BGM240S	BGM240P	RS9116	RS9116W
Industrial	Access Control	Bluetooth LE							✓				
	HMI	Bluetooth LE	✓		✓	✓	✓	✓				✓	✓
	HVAC	Bluetooth mesh							✓	✓	✓		
	Smart Buildings	Bluetooth mesh							✓	✓	✓		
	Predictive Maintenance	Bluetooth LE				✓	✓	✓	✓	✓	✓		
	Asset Tracking	Bluetooth LE	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Smart Cities	Livestock Management	Bluetooth LE				✓		✓	✓	✓			
	EV Charging	Bluetooth LE	✓	✓	✓	✓	✓	✓					✓
Commercial	Electronic Shelf Labels	Bluetooth LE				✓							
	Commercial Lighting	Bluetooth mesh	✓		✓				✓		✓		
	Enterprise Access Points	Bluetooth LE	✓						✓				
	Clinical Medical	Bluetooth LE				✓	✓	✓	✓	✓	✓	✓	✓
	Point of Sale	Bluetooth LE				✓	✓	✓	✓	✓	✓	✓	✓
	Indoor RTLS	Bluetooth LE				✓			✓				

Who is our competition?



Bluetooth Market Share

Total BLE semiconductor vendor unit market shares
(thousands of units)

Vendor	2019	2020
Nordic Semiconductor	34.0%	37.0%
Dialog Semiconductor	15.5%	13.0%
Telink	11.5%	12.0%
Texas Instruments	10.0%	8.5%
Qorvo	8.0%	8.0%
Universal Electronics	5.5%	6.5%
Silicon Labs	2.0%	4.0%
Infineon	3.0%	3.0%
Realtek	3.0%	2.5%
Qualcomm	2.5%	1.5%
STMicroelectronics	2.0%	1.5%
Other Vendors	1.0%	1.0%
NXP	1.5%	1.0%
Microchip	0.5%	0.5%
Share total	100.0%	100.0%
Total market	748,850	986,624

Notes: Share total may not sum to 100% because of rounding.
Source: Omdia

© 2021 Omdia

Top 4 Competitors



Where do they play?

▪ Nordic

- Dominates market and plays in all segments
- Good community and broad reach
- Few features standout (QSPI, USB, Voltage, WLCSP)

▪ **Dialog**

- Focus more on wearables, medical and consumer
- Device is Bluetooth as a peripheral
- Do not standout from a performance or power standpoint
- Mostly ROM / OTP parts

▪ **Telink**

- Aggressive on price
- Solid feature set
- Proprietary and RISC microcontroller

▪ **TI**

- Address broad market, but is losing market share
- Competitive product, but limited package options
- Commitment to Bluetooth LE market is not clear

Competition by Silicon Labs BUs					
Vendors/Applications	Home & Life		Industrial & Commerical		
	Connected Health	Smart Home	Smart Retail	Industrial IoT	Smart Cities
☐ Nordic					
nRF52805					
nRF52810					
nRF52811					
nRF52820					
nRF52832					
nRF52833					
nRF52840					
nRF5340					
☐ Dialog					
DA1453x					
DA14585					
DA14683					
DA1469x					
☐ Telink					
TLSR825x					
TLSR827x					
TLSR921x					
TLSR951x					
☐ TI					
CC2564x					
CC2640R2x					
CC2642R					
CC2651x3					
CC2652x7					
☐ Silicon Labs					
EFR32BG21					
EFR32BG22					
EFR32BG24					

Competitive Info on Dropbox - Dropbox (Silicon Labs)\IoT BU - Sales\Products\19. Competitive Info

References and Additional Content

- **Web Content**

- <https://www.silabs.com/wireless/bluetooth>
- [Bluetooth Selector Guide](#)
- [Bluetooth Low Energy Product Brief](#)
- [Bluetooth Mesh Learning Center](#)
- [Bluetooth Case Studies](#)
- [Bluetooth Development Kits](#)



Nordic 802.15.4 and Bluetooth Portfolio and Competitive Comparison



Contents

- **Nordic Product Overview**

- Nordic 802.15.4 and Bluetooth Product Portfolio

- **xG22 vs Nordic**

- xG22 vs Nordic Portfolio
- xG22 vs nRF52811 Comparison
- xG22 vs nRF52820 Comparison
- xG22 vs nRF52832 Comparison

- **xG24 vs Nordic**







- xG24 vs Nordic Portfolio
- xG24 vs nRF52840 Comparison
- xG24 vs nRF52840 Fighting Guide Summary
- xG24 vs nRF5340 Fighting Guide Summary



Nordic Portfolio Overview



Nordic 802.15.4 and Bluetooth Portfolio




	nRF52805/10/11 (July 2020)	nRF52820 (June 2020)	nRF52832 (Feb 2016)	nRF52833 (Nov 2019)	nRF52840 (Nov 2019)	nRF5340 (Dec 2020)
Protocols						
Freq. Bands	2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz
Core	Cortex®-M4 (64 MHz)	Cortex®-M4 (64 MHz)	Cortex®-M4 (64 MHz)	Cortex®-M4 (64 MHz)	Cortex®-M4 (64 MHz)	Cortex-M33 (128 MHz) Cortex-M33 (64 MHz)
Max Flash	192 kB	256 kB	512 kB	512 kB	1024 kB	1024 kB
Max RAM	24 kB	32 kB	64 kB	128 kB	256 kB	512 kB (App Core) 256 kB (Network Core)
Security	128-bit AES CCM, ECB, AAR	128-bit AES CCM, ECB, AAR	CryptoCell™-312	128-bit AES CCM	CryptoCell™-310	CryptoCell™-312
DS Operating Conditions	3V DCDC	3V DCDC	3V DCDC	3V DCDC	3V DCDC	3V DCDC
Max TX Power	+4 dBm	+8 dBm	+4 dBm	+8 dBm	+8 dBm	+3 dBm
RX Sensitivity (802.15.4)	-101 dBm	-99 dBm	NA	-99 dBm	-100 dBm	-101 dBm
RX Sensitivity (BLE 1 Mbps)	-96 dBm	-95 dBm	-96 dBm	-93 dBm	-95 dBm	-98 dBm
Active Current (CoreMark)	34.4 µA	33 µA	58 µA	52 µA	52 µA	62.5 µA
Sleep Current (running from LFRCO)	1.46 µA (16 kB*)	1.3 µA (16 kB*)	1.98 µA (16 kB*)	1.64 µA (16 kB*)	1.6 µA (16 kB*)	2.15 µA (16 kB*)
TX Current @ +0 dBm	5.8 mA	5.9 mA	7.1 mA	6.0 mA	6.4 mA	4.1 mA
TX Current @ +10 dBm	8 mA (+4 dBm)	15.0 mA (+8 dBm)	9.3 mA (+4 dBm*)	15.5 mA(+8 dBm)	16.4 mA(+8 dBm)	N/A
RX Current (802.15.4)	NA	6.0 mA	NA	6.2 mA	6.53 mA	3.9 mA
RX Current (BLE)	6.1 mA	5.8 mA	6.5 mA	6.0 mA	6.26 mA	3.7 mA
Serial Peripherals	SPI, TWI, UART, I2C	USB, UART, SPI, I2C, QDEC	SPI, TWI, I2S, UART, QDEC	USB, UART, SPI, I2C, QDEC	UART, SPI, I2C, QSPI, PPI, USB	UART, SPI, I2C, QSPI XIP, USB
Analog Peripherals	12-bit ADC	General-purpose comparator	12-bit ADC	12-bit ADC	12-bit ADC	12-bit ADC
Other	PDM	NA	PDM	PDM	PDM, NFC	PDM, NFC
Supply Voltage	1.7 – 3.6	1.7 – 5.5	1.7 – 3.6	1.7 – 5.5	1.7 – 3.6 V 2.5 – 5.5 V	1.7 – 3.6 V 2.5 – 5.5 V
Operating Temperature	-40 to +85 C	-40 to +105 C	-40 to +85 C	-40 to +105 C	-40 to +85 C	-40 to +105 C
Package	6x6 mm QFN48, 5x5 mm QFN32, 2.48x2.46 mm WLCSP33	5x5 mm QFN40, 2.53x2.53 mm WLCSP44	6x6 mm QFN48, 3.0x3.2 mm WLCSP50	7x7 mm aQFN73, 5x5 mm QFN40, 3.2x3.2 mm WLCSP	7x7 mm aQFN™73 6x6 mm QFN48 3.5x3.6 mm WLCSP95	7x7 aQFN94 4.4x4.0 WLCSP95



xG22 vs Nordic



xG22 vs Nordic Portfolio

	Silicon Labs xG22	nRF52805/10/11	nRF52820	nRF52832
Protocols				
Freq. Bands	2.4GHz	2.4 GHz	2.4 GHz	2.4 GHz
Core	Cortex-M33 (78 MHz) Cortex M0+ (Radio)	Cortex®-M4 (64 MHz)	Cortex®-M4 (64 MHz)	Cortex®-M4 (64 MHz)
Max Flash	512 kB	192 kB	256 kB	512 kB
Max RAM	32 kB	24 kB	32 kB	64 kB
Security	Secure Vault Mid	128-bit AES CCM, ECB, AAR	128-bit AES CCM, ECB, AAR	CryptoCell™-312
DS Operating Conditions	3V DCDC	3V DCDC	3V DCDC	3V DCDC
Max TX Power	+6 dBm	+4 dBm	+8 dBm	+4 dBm
RX Sensitivity (802.15.4)	-102.3 dBm (MG22)	-101 dBm	-99 dBm	NA
RX Sensitivity (BLE 1 Mbps)	-98.9 dBm	-96 dBm	-95 dBm	-96 dBm
Active Current (CoreMark)	37 µA/MHz	34.4 µA	33 µA	58 µA
Sleep Current (running from LFRCO)	1.26 µA (16 kB*)	1.46 µA (16 kB*)	1.3 µA (16 kB*)	1.98 µA (16 kB*)
TX Current @ +0 dBm	4.1 mA	5.8 mA	5.9 mA	7.1 mA
TX Current @ +10 dBm	8.2 mA (+6 dBm)	8 mA (+4 dBm)	15.0 mA (+8 dBm)	9.3 mA (+4 dBm*)
RX Current (802.15.4)	3.9 mA (MG22)	NA	6.0 mA	NA
RX Current (BLE)	3.6 mA	6.1 mA	5.8 mA	6.5 mA
Serial Peripherals	USART, EUART, I2C	SPI, TWI, UART, I2C	USB, UART, SPI, I2C, QDEC	SPI, TWI, I2S, UART, QDEC
Analog Peripherals	16-bit ADC	12-bit ADC	General-purpose comparator	12-bit ADC
Other	PDM, Temp Sensor, PLFRCO	PDM	NA	PDM
Supply Voltage	1.71 - 3.8 V	1.7 – 3.6	1.7 – 5.5	1.7 – 3.6
Operating Temperature	-40 to +125 C	-40 to +85 C	-40 to +105 C	-40 to +85 C
Package	4x4 QFN32 4x4 TQFN32 5x5 QFN40	6x6 mm QFN48, 5x5 mm QFN32, 2.48x2.46 mm WLCSP33	5x5 mm QFN40, 2.53x2.53 mm WLCSP44	6x6 mm QFN48, 3.0x3.2 mm WLCSP50

▪ nRF5205/10/11 Pros/Cons

- Limited Flash and RAM
- Low link budget
- Higher sleep current
- Limited hardware Encryption

▪ nRF52820 Pros/Cons

- Better Output Power
- Poor RX sensitivity
- Limited hardware Encryption
- Only 32 kB RAM


▪ nRF52832 Pros/Cons

- CryptoCell 312
- 64 kB RAM
- Poor RF sensitivity
- High active current consumption

▪ xG22 Pros/Cons

- Robust Security
- Better RF performance
- Low current consumption
- Only 32kB RAM

xG22 vs nRF52811 Comparison

	Silicon Labs xG22	Nordic nRF52811
Protocols		
Core	Cortex-M33 (76.8 MHz) Cortex M0+ (Radio)	Cortex-M4 (64 MHz)
Max Flash	512 kB	192 kB
Max RAM	32 kB	24 kB
Security	Arm TrustZone, Crypto Accelerator, Secure Vault Mid, SESIIP Assurance Level 3 with DTSec Protection Profile	AES Crypto (with AAR)
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+6 dBm	+4 dBm
RX Sensitivity (BLE 1Mbps)	-98.9 dBm	-96 dBm
RX Sensitivity (BLE 2 Mbps)	-96.2 dBm	-94 dBm
RX Sensitivity (BLE 125 Kbps)	-106.7 dBm	-104 dBm
Active Current (CoreMark)	37 µA (76.8 MHz)	34.4 µA (64 MHz)
Sleep Current (running from LFRCO)	1.26 µA (16 kB*)	1.46 µA (16 kB*)
TX Current @ +0 dBm	4.1 mA	5.8 mA
TX Current @ +6 dBm	8.2 mA	8 mA (+4 dBm)
RX Current (BLE)	3.6 mA	6.1 mA
Serial Peripherals	USART, EUART, I2C, I2S, PDM	UART, SPI, I2C, PDM, PPI, QDEC
Analog Peripherals	16-bit ADC	12-bit ADC
Other	PLFRCO, PDM	PDM
Supply Voltage	1.71 - 3.8 V	1.7 - 3.6 V
Operating Temperature	-40 to +125°C	-40 to +85°C
GPIO	18, 26	17, 32, 15
Package	4x4 QFN32 4x4 TQFN32 5x5 QFN40	5x5 QFN32 6x6 QFN48 2.482x2.464 WLCSP

Competitor Pros

- Robust Peripheral set including QDEC, and PPI
- More GPIOs for the 48-pin package

Competitor Cons

- Not enough Flash and RAM to run Thread SoC
- LFRC (32 KHz XTAL replacement) accuracy only guaranteed in constant temperature
 - BG22 PLFRCO works across the temp. range
- Security
 - No security certification, No Arm TrustZone
 - Lacks Secure Key Management
- High MCU & Radio power consumption
- Lower RF performance
 - 20% worse performance than BG22 for indoor range

How to Position the BG22

- Better RF performance
- PLFRCO can eliminate the need for external 32KHz xtal
- Lower power consumption, better sleep current
- Better security to protect keys and IP
- Better MCU core, & dedicated Radio core

xG22 vs nRF52820 Comparison

	Silicon Labs BG22	Nordic nRF52820
Protocols		
Core	Cortex-M33 (76.8 MHz) Cortex M0+ (Radio)	Cortex-M4 (64 MHz)
Max Flash	512 kB	256 kB
Max RAM	32 kB	32 kB
Security	Arm TrustZone, Crypto Accelerator, TRNG, Secure Vault Mid, SESIP Assurance Level 3 with DTSec Protection Profile	AES Crypto (with AAR), TRNG
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+6 dBm	+8 dBm
RX Sensitivity (BLE 1Mbps)	-98.9 dBm	-95 dBm
RX Sensitivity (BLE 2 Mbps)	-96.2 dBm	-92 dBm
RX Sensitivity (BLE 125 Kbps)	-106.7 dBm	-103 dBm
Active Current (CoreMark)	37 µA (76.8 MHz)	33 µA (64 MHz)
Sleep Current (running from LFRCO)	1.26 µA (16 kB*)	1.3 µA (16 kB*)
TX Current @ +0 dBm	4.1/3.4 mA	5.9 mA
TX Current @ +6 dBm	8.2/7.5 mA	15.0 mA (+8 dBm)
RX Current (BLE)	3.6/2.5 mA	5.8 mA
Serial Peripherals	USART, EUART, I2C, I2S, PDM	UART, SPI, I2C, PDM, PPI, QDEC, USB
Analog Peripherals	16-bit ADC	Comparator
Other	PLFRCO, PDM	PDM
Supply Voltage	1.71 - 3.8 V	1.7 – 5.5 V
Operating Temperature	-40 to +125°C	-40 to +105°C
GPIO	18, 26	18
Package	4x4 QFN32 4x4 TQFN32 5x5 QFN40	5x5 QFN40 2.531x2.531 WLCSP

Competitor Pros

- Robust Peripheral set including QDEC, and USB
- +8 dBm TX Output power and support for BT 5.2 Isochronous channels (for BLE Audio applications)



Competitor Cons

- Limited Flash
- LFRC (32 KHz XTAL replacement) accuracy only guaranteed in constant temperature
 - BG22 PLFRCO doesn't have this limitation and works across the temp. range
- Security
 - No security certification, No Arm TrustZone
 - Lacks Secure Key Management
- High MCU & Radio power consumption
- Lower RF performance
 - 25% worse performance than BG22 for indoor range
 - BG22 RX sensitivity is ~4 dB better than nRF52820, resulting in a ~2 dB higher link budget

How to Position the BG22

- Better RF performance
- PLFRCO can eliminate the need for external 32KHz xtal
- Better security to protect keys and IP
- Low power consumption
- Better MCU core, & dedicated Radio core

xG22 vs nRF52832 Comparison

	Silicon Labs BG22	Nordic nRF52832
Protocols		
Freq. Bands	2.4GHz	2.4 GHz
Core	Cortex-M33 (76.8 MHz) Cortex M0+ (Radio)	Cortex-M4 (64 MHz)
Max Flash	512 kB	512 kB
Max RAM	32 kB	64 kB
Security	Arm TrustZone Secure Vault Mid SESiP Assurance Level 3 with DTSec Protection Profile	Arm TrustZone Arm CryptoCell™-312
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+6 dBm	+4 dBm
RX Sensitivity (BLE 1Mbps)	-98.9 dBm	-96 dBm
RX Sensitivity (BLE 2 Mbps)	-96.2 dBm	-93 dBm
Active Current (CoreMark)	37 µA	58 µA
Sleep Current (running from LFRCO)	1.26 µA (16 kB*)	1.98 µA (16 kB*)
TX Current @ +0 dBm	4.1/3.4 mA	7.1 mA
TX Current @ +6 dBm	8.2/7.5 mA	9.3 mA (+4 dBm*)
RX Current (BLE)	3.6/2.5 mA	6.5 mA
Serial Peripherals	USART, EUART, I2C, I2S, PDM	UART, SPI, I2C, I2S, PDM, PPI, QDEC, NFC
Analog Peripherals	16-bit ADC	12-bit ADC
Other	PLFRCO, PDM	PDM
Supply Voltage	1.71 - 3.8 V	1.7 - 3.6 V
Operating Temperature	-40 to +125°C	-40 to +85°C
GPIO	18, 26	32, 32
Package	4x4 QFN32 4x4 TQFN32 5x5 QFN40	6x6 QFN48 3.0x3.2 WLCSP

Competitor Pros

- More RAM
- Robust Peripheral set including QDEC, and NFC
 - NFC-A tag for use in simplified pairing & payment solutions
- More GPIOs offered in a tiny WLCSP package

Competitor Cons

- LFRC (32 KHz XTAL replacement) accuracy only guaranteed in constant temperature
 - BG22 PLFRCO doesn't have this limitation and works across the temp. range
- Security
 - No security certification
 - Lacks Secure Key Management
- High active current consumption with lower clock speed
- No support for Bluetooth Location Services
- Lower RF performance
 - 30% worse performance than BG22 for indoor range

How to Position the BG22

- Better RF performance
- PLFRCO can eliminate the need for external 32KHz xtal
- Lower active current for better battery life
- Better MCU core, & dedicated Radio core
- Smaller QFN package options



Fighting Guide



xG24 vs Nordic Comparison

	Silicon Labs xG24	nRF52833	nRF52840	nRF5340
Protocols				
Freq. Bands	2.4GHz	2.4 GHz	2.4 GHz	2.4 GHz
Core	Cortex-M33 (78 MHz) Cortex M0+ (Radio) Cortex M0+ (Security)	Cortex-M4 (64 MHz)	ARM® Cortex®-M4 32-bit processor with FPU, 64 MHz	Cortex-M33 (128 MHz) Cortex-M33 (64 MHz)
Max Flash	1536 kB	512 kB	1 MB	1024 kB
Max RAM	256 kB	128 kB	256 kB	512 kB (App Core) 256 kB (Network Core)
Security	Secure Vault™ Mid Secure Vault™ High	128-bit AES CCM, ECB, AAR	CryptoCell™-310	CryptoCell™-312
DS Operating Conditions	3V DCDC	3V DCDC	3V DCDC	3V DCDC
Max TX Power	+19.5 dBm	+8 dBm	+8 dBm	+3 dBm
RX Sensitivity (802.15.4)	-105.4 dBm	-99 dBm	-100 dBm	-101 dBm
RX Sensitivity (BLE 1 Mbps)	-97.6 dBm	-93 dBm	-95 dBm	-98 dBm
Active Current (CoreMark)	49.1 µA	52 µA	52 µA	62.5 µA
Sleep Current (running from LFRCO)	1.3 µA (16 kB)	1.64 µA (16 kB*)	1.6 µA (16 kB*)	2.15 µA (16 kB*)
TX Current @ +0 dBm	5.0 mA	6.0 mA	6.4 mA	4.1 mA
TX Current @ +10 dBm	19.1 mA	15.5 mA(+8 dBm)	16.4 mA(+8 dBm)	N/A
RX Current (802.15.4)	5.1 mA	6.2 mA	6.53 mA	3.9 mA
RX Current (BLE)	4.4 mA	6.0 mA	6.26 mA	3.7 mA
Serial Peripherals	USART, EUSART, I2C	SPI, UART, I2S	UART, SPI, I2C, QSPI, PPI, USB	UART, SPI, I2C, QSPI XIP, USB
Analog Peripherals	20-bit ADC, ACMP, VDAC	12-bit ADC	12-bit ADC	12-bit ADC
Other	Die Temp Sensor	PDM	PDM, NFC	PDM, NFC
Supply Voltage	1.71 - 3.8 V	1.7 – 5.5V	1.7 – 3.6 V 2.5 – 5.5 V	1.7 – 3.6 V 2.5 – 5.5 V
Operating Temperature	-40 to +125 C	-40 to +105 C	-40 to +85 C	-40 to +105 C
Package	5x5 QFN40, 6x6 QFN48	7x7 mm aQFN73, 5x5 mm QFN40, 3.2x3.2 mm WLCSP	7x7 mm aQFN™73 6x6 mm QFN48 3.5x3.6 mm WLCSP95	7x7 aQFN94 4.4x4.0 WLCSP95

■ nRF52833 Pros/Cons

- Better Supply Voltage Range
- Flash will limit this device to Bluetooth
- Poor RF Performance
- High Active Current

■ nRF52840 Pros/Cons

- Robust Peripheral set including QSPI, USB and NFC
- CryptoCell-310
- Lower RF performance
- Higher current consumption



■ nRF5340 Pros/Cons

- Multiple core and large amount of RAM
- Robust Peripheral set including QSPI, USB and NFC
- Poor RF performance
- Higher current consumption

■ xG24 Pros/Cons

- Better RF performance for robust RF
- Lower current for better battery life
- Secure Vault High protects against local attacks
- More embedded Flash eliminates need for external flash

xG24 vs nRF52833 Comparison

	Silicon Labs xG24	Nordic nRF52833
Protocols		
Freq. Bands	2.4GHz	2.4 GHz
Core	Cortex-M33 (78 MHz) Cortex M0+ (Radio) Cortex M0+ (Security)	Cortex-M4 (64 MHz)
Max Flash	1536 kB	512 kB
Max RAM	256 kB	128 kB
Security	Secure Vault Mid Secure Vault High	128-bit AES CCM, ECB, AAR
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+20 dBm	+8 dBm
RX Sensitivity (802.15.4)	-105.4 dBm	-99 dBm
RX Sensitivity (BLE 1 Mbps)	-97.6 dBm	-93 dBm
Active Current (CoreMark)	49.1 µA	52 µA
Sleep Current (running from LFRCO)	1.3 µA (16 kB)	1.64 µA (16 kB*)
TX Current @ +0 dBm	5.0 mA	6 mA
TX Current @ +10 dBm	19.1 mA	15.50 mA (+8 dBm)
RX Current (802.15.4)	5.1 mA	6.2 mA
RX Current (BLE)	4.4 mA	6 mA
Serial Peripherals	USART, EUSART, I2C	SPI, UART, I2S
Analog Peripherals	20-bit ADC, ACMP, VDAC	12-bit ADC
Other	Die Temp Sensor	PDM
Supply Voltage	1.71 - 3.8 V	1.7 – 5.5V
Operating Temperature	-40 to +125 C	-40 to +105 C
Package	5x5 QFN40, 6x6 QFN48	7x7 mm aQFN73, 5x5 mm QFN40, 3.2x3.2 mm WLCSP

Competitor Pros

- More Packaging size options
- Better Supply Voltage Range



Competitor Cons

- Less Flash Memory and RAM
 - Will limit this part to BT or RCP configurations
- Low security and limited hardware encryption
- Higher Current Consumption

How to Position the MG24

- Better RF range and reliability for robust RF
 - MG24 provides at least 30% improvement in range
- Lower current for better battery life
- Secure Vault provide much higher level of security
- More embedded Flash eliminates need for external flash
 - Reduced BOM reduces cost and size

xG24 vs nRF52840 Fighting Guide Summary

	Silicon Labs xG24	Nordic nRF52840
Protocols		
Freq. Bands	2.4GHz	2.4 GHz
Core	Cortex-M33 (78 MHz) Cortex M0+ (Radio) Cortex M0+ (Security)	ARM® Cortex®-M4 32-bit processor with FPU, 64 MHz
Max Flash	1536 kB	1 MB
Max RAM	256 kB	256 kB
Security	Secure Vault Mid Secure Vault High	Arm TrustZone CryptoCell™-310
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+20 dBm	+8 dBm
RX Sensitivity (802.15.4)	-105.4 dBm	-100 dBm
RX Sensitivity (BLE 1 Mbps)	-97.6 dBm	-95 dBm
Active Current (CoreMark)	49.1 µA	52 µA
Sleep Current (running from LFRCO)	1.3 µA (16 kB)	1.6 µA (16 kB*)
TX Current @ +0 dBm	5.0 mA	6.4 mA
TX Current @ +10 dBm	19.1 mA	16.4 mA(+8 dBm)
RX Current (802.15.4)	5.1 mA	6.53 mA
RX Current (BLE)	4.4 mA	6.26 mA
Serial Peripherals	USART, EUSART, I2C	UART, SPI, I2C, QSPI, PPI, USB
Analog Peripherals	20-bit ADC, ACMP, VDAC	12-bit ADC
Other	Die Temp Sensor	PDM, NFC
Supply Voltage	1.71 - 3.8 V	1.7 – 3.6 V 2.5 – 5.5 V
Operating Temperature	-40 to +125 C	-40 to +85 C
Package	5x5 QFN40, 6x6 QFN48	7x7 mm aQFN™73 6x6 mm QFN48 3.5x3.6 mm WLCSP95

Competitor Pros

- Robust Peripheral set including QSPI, USB and NFC
- CryptoCell-310
 - Does not protect from local attacks

Competitor Cons

- Lower RF performance
- Higher current consumption
- Will need external Flash for Matter for OTA



How to Position the MG24

- Better RF range and reliability for robust RF
 - MG24 provides at least 30% improvement in range
- Lower current for better battery life
- Secure Vault High protects from local attacks
- More embedded Flash eliminates need for external flash
 - Reduced BOM reduces cost and size

See EFR32MG24 vs Nordic nRF52840 Fighting Guide for detailed information

xG24 vs nRF5340 Fighting Guide

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	Silicon Labs xG24	Nordic nRF5340
Protocols		
Freq. Bands	2.4GHz	2.4 GHz
Core	Cortex-M33 (78 MHz) Cortex M0+ (Radio) Cortex M0+ (Security)	Cortex-M33 (128 MHz) Cortex-M33 (64 MHz)
Max Flash	1536 kB	1024 kB
Max RAM	256 kB	512 kB (App Core) 256 kB (Network Core)
Security	ArmTrustZone Secure Vault™ Mid Secure Vault™ High	Arm TrustZone CryptoCell™-312
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+19.5 dBm	+3 dBm
RX Sensitivity (802.15.4)	-105.4 dBm	-101 dBm
RX Sensitivity (BLE 1 Mbps)	-97.6 dBm	-98 dBm
Active Current (CoreMark)	49.1 µA	62.5 µA
Sleep Current (running from LFRCO)	1.3 µA (16 kB)	2.15 µA (16 kB*)
TX Current @ +0 dBm	5.0 mA	4.1 mA
TX Current @ +10 dBm	19.1 mA	N/A
RX Current (802.15.4)	5.1 mA	3.9 mA
RX Current (BLE)	4.4 mA	3.7 mA
Serial Peripherals	USART, EUSART, I2C	UART, SPI, I2C, QSPI XIP, USB
Analog Peripherals	20-bit ADC, ACMP, VDAC	12-bit ADC
Other	Die Temp Sensor	PDM, NFC
Supply Voltage	1.71 - 3.8 V	1.7 – 3.6 V 2.5 – 5.5 V
Operating Temperature	-40 to +125 C	-40 to +105 C
Package	5x5 QFN40, 6x6 QFN48	7x7 aQFN94 4.4x4.0 WLCSP95

Competitor Pros

- Multiple core and large amount of RAM
- Robust Peripheral set including QSPI, USB and NFC
- CryptoCell-312

- ▶ Does not protect from local attacks

Competitor Cons

- Overkill for IoT end devices
 - ▶ Targets wearables and Bluetooth LE audio applications
- Poor RF performance
 - ▶ Will require a FEM for most mesh applications (+\$0.30-\$0.60)
- Higher current consumption
 - ▶ Multiple cores RAM will lead to higher system level current



How to Position the MG24

- Better RF performance for robust RF
- Lower current for better battery life
- Lower BOM reduces cost and size
- Secure Vault High protects against local attacks
- More embedded Flash eliminates need for external flash

See EFR32MG24 vs Nordic nRF5340 Fighting Guide for detailed information

BG22 vs TI CC2340 Competitive Summary

Announced	June 2022
Availability	No info available
Data Sheet	No info available

	Silicon Labs BG22	TI CC2340
Protocols		
Freq. Bands	2.4GHz	2.4 GHz
Core	Cortex-M33 (78 MHz) Cortex M0+ (Radio)	Cortex-M0+ (48 MHz)
Max Flash	512 kB	512 kB
Max RAM	32 kB	36 kB
Security	Secure Vault Mid	AES-128
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+6 dBm	+8 dBm
RX Sensitivity (802.15.4)	-102.3 dBm (MG22)	TBD
RX Sensitivity (BLE 1 Mbps)	-98.9 dBm	-96 dBm
Active Current (CoreMark)	37 μ A/MHz	55 μ A/MHz
Sleep Current (16 kB ret EM2)	1.2 μ A	<830nA
TX Current @ +0 dBm	4.1 mA	<5.3 mA
TX Current @ +10 dBm	8.2 mA (+6 dBm)	TBD (+8 dBm)
RX Current (802.15.4)	3.9 mA (MG22)	TBD
RX Current (BLE)	3.6 mA	TBD
Serial Peripherals	USART, EUSART, I2C	UART, SPI, I2C
Analog Peripherals	16-bit ADC	ADC
Other	PDM, Temp Sensor, PLFRCO	Temp Sensor
Supply Voltage	1.71 - 3.8 V	1.71 - 3.8 V
Operating Temperature	-40 to +125 C	-40 to +125 C
Package	4x4 QFN32 (18 GPIO) 4x4 TQFN32 (18 GPIO) 5x5 QFN40 (26 GPIO)	4x4 QFN (11 GPIO) 5x5 QFN (26 GPIO)



Competitor Cons

- M0+ Core with lower clock speed
- Limited security features
- Higher active current
- No mention of capabilities to eliminate 32KHz xtal

How to Position the BG22

- Low active current can offset TI low sleep current
- PLFRCO can eliminate the need for external 32KHz xtal
- BG22 provides better protection from attacks
- Lower output power is offset by higher sensitivity
- Available now

BG22 vs STM32WB35CE Fighting Guide Summary

	Silicon Labs BG22	ST STM32WB35CE
Protocols		
Freq. Bands	2.4GHz	2.4 GHz
Core	Cortex-M33 (76.8 MHz) Cortex M0+ (Radio)	Cortex-M4 (64 MHz) Cortex-M0+ (Radio)
Max Flash	512 kB	512 kB
Max RAM	32 kB	96 kB
Security	Secure Vault Mid SESIP Assurance Level 3 with DTSec Protection Profile	Public key acceleration (RSA, Diffie-Helman, ECC)
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+6 dBm	+6 dBm
RX Sensitivity (BLE 1Mbps)	-98.9 dBm	-96 dBm
RX Sensitivity (BLE 2 Mbps)	-96.2 dBm	-93 dBm
Active Current (CoreMark)	37 µA	125 µA
Sleep Current (32 kB ret)	1.4 µA	0.915 µA
TX Current @ +0 dBm	4.1 mA	5.2 mA
TX Current @ +6 dBm	8.2 mA	7.8 mA
RX Current (BLE)	3.6 mA	4.5 mA
Serial Peripherals	USART, EUART, I2C	UART, SPI, I2C, QPSI, USB
Analog Peripherals	16-bit ADC	16-bit ADC
Other	PLFRCO, PDM	PDM
Supply Voltage	1.71 - 3.8 V	1.7 – 3.6 V
Operating Temperature	-40 to +125°C	-40 to +105°C
GPIO	18, 26	26
Package	4x4 QFN32 4x4 TQFN32 5x5 QFN40	7x7 UFQFPN48

Competitor Pros

- More RAM
- Robust Peripheral set including QSPI, and USB
- Low sleep current
 - Some benchmarking has shown higher power consumption

Competitor Cons


- Lower RF performance
 - 20% worse performance than BG22 for indoor range
 - RF specs are at 3.3 volts
 - Enabling SMPS (DCDC) degrades RF performance
- Security
 - No security certification
 - Lacks DPA countermeasures
- High active current consumption with lower clock speed
- Large package with same amount of GPIOs as BG22
- No support for Bluetooth Location Services

How to Position the BG22

- Better RF performance
- PLFRCO can eliminate the need for external 32KHz xtal
- Lower active current for better battery life
- Better security to protect keys and IP
- Smaller package

See EFR32BG22 vs STM32WB35CE Fighting Guide for detailed information

BG22 vs RSL15 Fighting Guide Summary

	Silicon Labs BG22	Onsemi RSL15
Protocols		
Freq. Bands	2.4GHz	2.4 GHz
Core	Cortex-M33 (76.8 MHz) Cortex M0+ (Radio)	Cortex-M33 (48 MHz)
Max Flash	512 kB	512 kB
Max RAM	32 kB	64 kB
Security	Secure Vault Mid SESIP Assurance Level 3 with DTSec Protection Profile Arm TrustZone	CryptoCell™ 312 Secure Key Management Arm TrustZone
DS Operating Conditions	3V DCDC	3V DCDC
Max TX Power	+6 dBm	+6 dBm
RX Sensitivity (BLE 1Mbps)	-98.9 dBm	-96 dBm
RX Sensitivity (BLE 2 Mbps)	-96.2 dBm	-94 dBm
Active Current (CoreMark)	37 µA	30 µA
Sleep Current (32 kB ret)	1.4 µA	0.311 µA
TX Current @ +0 dBm	4.1 mA	4.3 mA
TX Current @ +6 dBm	8.2 mA	11.4 mA
RX Current (BLE)	3.6 mA	2.7 mA
Serial Peripherals	USART, EUSART, I2C, PDM	UART, SPI, I2C, QPSI, PCM
Analog Peripherals	16-bit ADC	12-bit ADC
Other	PLFRCO, PDM	PDM
Supply Voltage	1.71 - 3.8 V	1.2 – 3.6 V
Operating Temperature	-40 to +125°C	-40 to +85°C
GPIO	18, 26	15
Package	4x4 QFN32 4x4 TQFN32 5x5 QFN40	5x5 QFN40

Competitor Pros

- More RAM
- Robust Peripheral set including QSPI
- Better Security Engine (CryptoCell™ 312)
- Low sleep current
- Low RX current
- Wide operating voltage range – 1.2 to 3.6 V

Competitor Cons

- Poor software and tools support
- Lower RF performance
 - ▶ 20-25% worse performance than BG22 for indoor range
- No security certification
- Lower clock speed
- Limited number of GPIO count

How to Position the BG22

- Better RF performance
- Dedicated Radio core
- PLFRCO can eliminate the need for external 32KHz xtal
- Smaller package (we offer PCB, SIP packages and modules)
 - ▶ More GPIO even in our smaller package

See EFR32BG22 vs RSL15 Fighting Guide for detailed information