Release Notes – RS9116.NB0.NL.GNU.LNX.OSD.2.0.0.0024

Monday October 19th, 2020

The **RS9116 n-Link™** products provide single band Wi-Fi (2.4GHz, 802.11bgn 1x1) and dual band Wi-Fi (2.4/5GHz, 802.11abgn 1x1) connectivity in systems which have 32/64-bit host processor/ microcontroller running Linux OS. These products come up with a rich source of interfaces allowing maximum flexibility of integration into any host processor/ microcontroller systems. These can be interfaced over interfaces like SDIO, USB bus to host processor / microcontroller where generic TCP/IP network stack and Wireless stacks/profiles running.

These n-Link products capable up to 100 Mbps Wi-Fi application throughputs with multiple operating modes such as Wi-Fi Client and Wi-Fi Access Point.

Open Source Driver (OSD) is a SoftMAC driver which interacts with the Linux wireless MAC layer MAC80211. The contents of this driver will be submitted to kernel community continuously and can be found in Linux kernel distributions.

Release Highlights

- Added dual band bgscan support and hidden SSID bgscan support.
- Added GPIO's configuration provision for power save GPIO handshake.
- Added support to fix the rate for data packets.
- Enhanced auto rate functionality to improve the throughput performance in chaotic environments.
- Changes for ACS in AP mode to adhere with MAC80211 scanning.
- Added validity checks to BGscan configuration parameters through debugfs.
- Fixed connected STA's inactivity timeout handling issue in AP mode.
- Fixed bug in handling 11b protection.
- Fixed bug in enabling RTS/CTS protection.
- Fixed issues in PN validation for Group data packets.

Table of Contents

Introduction

This document offers users of Silicon Labs software with an insight to the changes found between different releases.

Document reference

New Features	These items are new to this release.
Changes/Issues fixed	These are the changes made to existing features found in previous releases of the software. These are not considered bugs but enhancements to existing product flow and feature set.
	Features that do not or have not functioned as intended that are repaired as part of this release.
Limitations/ Recommendations	Describes what are the limitations on how we use the product and recommendations for optimal use cases.

Reference documentation for RS9116 nLink software

- RS9116 nLink OSD Software

RS9116 nLink OSD software documentation is available online at
https://docs.silabs.com/rs9116/
The online documentation includes:
- Evaluation Kit User's Guide
- Technical Reference Manual
- Raspberry Pi platform user guide.

Software Compatibility

-

Support

-

Release Notes – RS9116.NB0.NL.GNU.LNX.OSD.2.0.0.0024

Monday 19th October 2020

Release type

- Test ☐
- Alpha ☐
- Beta ☐
- Production ☑

Release Details

- Package Name : RS9116.NB0.NL.GNU.LNX.OSD.2.0.0.0024
- Firmware Version : 1610.2.0.0.0024
- Hardware Modules/chipsets : Q7, B00, C00, CC1, AB0, AB1, AA0, AA1
- Supported Linux Kernel Versions : From v3.18. to v5.7
- Host interfaces supported : USB, SDIO
- Operating modes supported : Wi-Fi STA, Wi-Fi AP, Wi-Fi STA + BLE, Wi-Fi STA + BT, BT + BLE

New Features

Wi-Fi

- Added Dual Band bgscan support.
- Added hidden SSID bgscan support.
- Added GPIO's configuration provision for power save GPIO handshake.
- Added support to enable "fixed rate for data packets".
- Support for WPA3-PSK in STA mode.
- Dynamic configuration of feature parameters through debugfs.

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

- Sweyntooth Vulnerability Fixes.

Changes/Issues Fixed

Wi-Fi

- Fixed issues in suspend /resume functionality.

- Enhanced auto rate functionality to improve the throughput performance in noisy environments.
- Changes for Auto Channel Selection (ACS) in AP mode to adhere with MAC80211 scanning.
- Added validity checks to BGscan configuration parameters through debugfs configuration utility.
- Fixed connected STA's inactivity timeout handling issue in AP mode.
- Fixed compilation issue with 3.18 kernel.
- Fixed bug in handling 11b protection.
- Fixed bug in enabling RTS/CTS protection.
- Added limits to the beacon interval configuration in AP mode and added note in TRM for range of values.
- Fixed issues in CCMP security packet number (PN) validation for Group data packets.
- Fixed bug in handling USB disconnection.

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Recommended Configuration:

Wi-Fi

-None-

BT /BLE

- In BLE, recommended range of Connection Interval in
    - Power Save (BLE Only) - 100ms to 1.28sec.
    - BT Classic + BLE Dual Mode is >= 200ms.
    - Wi-Fi + BLE coex - 30ms to 250ms
- In BLE, during Connection, configuration of Scan Interval and Scan Window with same value is not recommended.
- In BT Classic, recommended Sniff Interval configuration during Power Save is limited to 100ms (<= 100).
- In Wi-Fi + BT Classic coex, for BT file transfer to work fine, recommended value of Wi-Fi protocol DTIM is more than 3 and Beacon Interval is more than 200ms.
- In Wi-Fi + BLE, during Wi-Fi connection, recommending the lesser BLE scan Window and larger BLE scan Interval.

- In BLE mode, if advertising is in progress and subsequently it gets connected and moves to slave role, then advertising stops. To further get connected as multiple slaves, application should give command for starting advertising again.
- In BLE, if device is acting as Master/Slave, Scan Window (in set_scan_params and create_connection command) shall be less than or equal to the existing Connection Interval.
- In BLE mode, if scanning and advertising is in progress and subsequently it gets connected and moves to master role, then scanning and advertising stops. To further establish connection to another slave device or to a master device, application should give command for starting advertising and scanning again.

Co-Ex

- In Wi-Fi + BLE, during Wi-Fi connection, lesser BLE scan Window and larger BLE scan Interval is recommended
- For Wi-Fi+BT+BLE operating mode, recommendation is to connect Wi-Fi ahead of BT/BLE connections, to ensure seamless stable connection of all 3 protocols
- For Wi-Fi+BT+BLE operating mode, if BT/BLE needs to be connected ahead of Wi-Fi connection, recommendation is to connect with high supervision timeout and high connection interval and sniff interval respectively for BLE and BT, to ensure seamless stable connection. This configuration will also ensure stable BT/BLE connection in the scenario where Wi-Fi connects/disconnects/rejoins.

Known Issues

Wi-Fi

- Set data rate capability is not supported for non MCS (11a/b/g) and non-basic rates in kernels above 4.13.16.
- Reading Transmit rate through 'iw dev' will not show correct value.
- EAP-TLS not supported in this release.
- Auto Channel Selection in AP with WORLD region will not work.
- Partial vulnerability to Kr00k. Being fixed in the next upcoming release.
- Connection to hidden mode AP in DFS channels may not work.
- Security and TX rate verification through iwconfig is not supported.

BT /BLE

- BT-HID might not inter-operate with Apple devices
- In Wi-Fi + BT/BLE coex modes, has limitations as specified in the below BT specific sections.

Co-Ex

- Wi-Fi + BLE operating mode configuration, BLE might disconnect with connection interval higher than 250ms
- Wi-Fi + BLE: BLE disconnection might be observed with Wi-Fi + BLE configuration with Wi-Fi continuous data transfer for low BLE supervision timeout configured. If Supervision timeout is configured as 16 seconds then no disconnections will be observed.
- WiFi+BT+BLE: If for some reason Wi-Fi disconnects, then it is observed that BT/BLE might not reconnect on a disconnection. Can be recovered through Wireless de-init followed by Wireless init.

Limitations/Feature Not Supported

Wi-Fi

- RF Regulatory test mode (PER) is not supported in this release. (Please refer TRM for using Proprietary Driver for this purpose).
- AMSDU TX is not supported
- Fragmentation is not supported.
- AMSDU's within AMPDU is not supported.
- Wi-Fi 2G 40Mhz is not supported.
- 11j not supported.
- AP mode more than 16 clients not supported.
- CW Mode is not supported.
- CCX & 11k not supported.
- USB ULP is not supported.
- External 3-wire coexistence is not supported.
- LP Power save using GPIO handshake is not supported.
- DFS Master in AP is not supported.
- Radar detection in STA mode is not supported.

BT /BLE

- BT Sniff mode does not work if BT multiple slaves feature is enabled.
- When BT multiple slaves feature is enabled, Master to slave role switch will not happen.
- BT Classic: Simultaneous Slave & Master roles (Scatter-net) are not supported.
- For BLE, if connection is established with small connection interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.

Co-Ex

- Wi-Fi + BLE: During Wi-Fi connection, if both BLE scan interval and window are same then there will be issue in successfully making the Wi-Fi connection.
- Wi-Fi + BLE CoEx: If BLE Connection is established with small Connection Interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.

- Wi-Fi+BT+BLE and BT+BLE: When Wi-Fi connected and BT data transfer (L2 Test) may not happen after connecting BLE in dual mode.
- Wi-Fi + BLE: Wi-Fi data transfer might be stopped, when initiated scanning from BLE device.

Folder Structure Changes

-None-

Release Notes – RS911X.NB0.NL.GNU.LNX.2.0.RC6

Date: Tuesday 26th May 2020

Release type

- Test ☐
- Alpha ☐
- Beta ☐
- Production ☑

Release Details

- Package Name   : RS911X.NB0.NL.GNU.LNX.2.0.RC6
- Firmware Version   : 1610.1.2.23.0017
- Hardware Modules/chipsets   : Q7, B00, C00, CC1, AB0, AB1, AA0, AA1
- Supported Linux Kernel Versions   : From v3.18. to v5.3
- Host interfaces supported   : USB, SDIO

New Features

Wi-Fi

- Added debugfs entries for Power save configuration parameters
- Added support for USB v1.2

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Changes/Issues Fixed

Wi-Fi

- Fixed scan and bgscan issues.
- Fixed slow platforms failure while running full throughput.
- Added fixes to improve throughput.

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Common Limitations/Feature Not Supported

- M15DB-T & M15DB modules are not supported

Wi-Fi Limitations/Feature Not Supported

- AMSDU TX is not supported
- Fragmentation is not supported.
- AMSDU's within AMPDU is not supported.
- WLAN Performance is less in dense environments.
- WLAN 2G 40Mhz has Performance issues.
- Digital Loopback is not supported
- PUF is not supported
- AP mode more than 32 clients not supported,AP + BT + BLE has only 4 clients support
- CW Mode is not supported
- RF Loopback modes M2,M3 are not supported
- USB ULP is not supported
- WMM-Admission Control is not supported
- LP Powersave using GPIO handshake is not supported

BT/BLE Recommendations

- In BLE, recommended range of Connection Interval in
  - Power Save - 100ms to 1.28sec.
  - BT Classic + BLE Dual Mode is >= 200ms.
  - Wi-Fi + BLE coex - 30ms to 4sec
- In BLE, during Connection, same values of Scan Interval and Scan Window is not recommended.
- In BT Classic, recommended value of Sniff Interval during Power Save is limited to 100ms (<= 100).
- In Wi-Fi + BT Classic coex, for BT file transfer to work fine, recommended value of Wi-Fi protocol DTIM is more than 3 and Beacon Interval is more than 200ms.

BT/BLE Limitations/Features Not Supported

1. BT Sniff mode does not work if BT multiple slaves feature is enabled.
2. When BT multiple slaves feature is enabled, Master to slave role switch will not happen.
3. In BLE, if Advertising/Scanning are in progress, and the device moves to Slave/Master role, Advertising/Scanning will be stopped. Provide respective commands to start Advertising/Scanning while being in Slave/Master role.

4. In Wi-Fi + BLE coex, if BLE Connection is established with small Connection Interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.
5. Observed glitches in BT audio in coex mode when Wi-Fi is connected.
6. In BLE, if device is acting as Master/Slave, Scan Window (in set_scan_params and create_connection command) shall be less than the existing Connection Interval.
7. In BLE, if Advertising/Scanning are in progress, and the device moves to Slave/Master role, Advertising/Scanning will be stopped. Provide respective commands to start Advertising/Scanning while being in Slave/Master role.
8. In BLE, if BLE Connection is established with small Connection Interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.

Folder Structure Changes

-None-

Release Notes – RS911X.NB0.NL.GNU.LNX.2.0.RC5

Date : Monday 10th Feb 2020

Release Status

- Test   ☑
- Alpha   ☐
- Beta   ☐
- Production   ☐

Supported Linux Kernel Versions:

- Kernel versions from 3.18 to 5.3

Host Interfaces Supported:

- USB
- SDIO

New Features

Wi-Fi

-None-

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Changes/Issues Fixed

Wi-Fi

- Addressed connection timeout issues with power save.
- Addressed SDIO RX failures on low end platforms.
- Fixed suspend /resume issues.

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Common Limitations/Feature Not Supported

- M15DB-T & M15DB modules are not supported

WLAN Limitations/Feature Not Supported

- AMSDU TX is not supported
- Fragmentation is not supported.
- AMSDU's within AMPDU is not supported.
- WLAN Performance is less in dense environments.
- WLAN 2G 40Mhz has Performance issues.
- Digital Loopback is not supported
- PUF is not supported
- AP mode more than 32 clients not supported,AP + BT + BLE has only 4 clients support
- CW Mode is not supported
- RF Loopback modes M2,M3 are not supported
- USB ULP is not supported
- WMM-Admission Control is not supported
- LP Powersave using GPIO handshake is not supported

BT/BLE Recommendations

- In BLE, recommended range of Connection Interval in
  - Power Save - 100ms to 1.28sec.
  - BT Classic + BLE Dual Mode is >= 200ms.
  - Wi-Fi + BLE coex - 30ms to 4sec
- In BLE, during Connection, same values of Scan Interval and Scan Window is not recommended.
- In BT Classic, recommended value of Sniff Interval during Power Save is limited to 100ms (<= 100).
- In Wi-Fi + BT Classic coex, for BT file transfer to work fine, recommended value of Wi-Fi protocol DTIM is more than 3 and Beacon Interval is more than 200ms.

BT/BLE Limitations/Features Not Supported

9. BT Sniff mode does not work if BT multiple slaves feature is enabled
10. When BT multiple slaves feature is enabled, Master to slave role switch will not happen
11. In BLE, if Advertising/Scanning are in progress, and the device moves to Slave/Master role, Advertising/Scanning will be stopped. Provide respective commands to start Advertising/Scanning while being in Slave/Master role.

12. In Wi-Fi + BLE coex, if BLE Connection is established with small Connection Interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.
13. Observed glitches in BT audio in coex mode when Wi-Fi is connected
14. In BLE, if device is acting as Master/Slave, Scan Window (in set_scan_params and create_connection command) shall be less than the existing Connection Interval.
15. In BLE, if Advertising/Scanning are in progress, and the device moves to Slave/Master role, Advertising/Scanning will be stopped. Provide respective commands to start Advertising/Scanning while being in Slave/Master role.
16. In BLE, if BLE Connection is established with small Connection Interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.

Folder Structure Changes

-None-

Release Notes – RS911X.NB0.NL.GNU.LNX.2.0.RC4

Date: Friday 3rd January 2020

Release Status

- Test   ☑
- Alpha   ☐
- Beta   ☐
- Production ☐

Supported Linux Kernel Versions:

- Kernel versions from 3.18 to 5.3

Host Interfaces Supported:

- USB
- SDIO

New Features

Common

- Added support for ULP with message / GPIO handshake.
- Added support for USB auto suspend.

Wi-Fi

- Added support fro 11W(MFP)
- Added support for Sniffer mode
- Added support for WPA3

Bluetooth - Common

   -None-

Bluetooth – Classic

   -None-

Bluetooth – LE

   -None-

Changes/Issues Fixed

Common

- Fixed stability and functional issues raised by QA and customers.
- Fixed nLink driver regression issues.

Wi-Fi

-None-

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Limitations/Feature Not Supported

- AMSDU TX is not supported.
- Fragmentation is not supported.
- AMSDU's within AMPDU is not supported.
- Access Point mode through CFG80211 is supported for only kernel versions greater than 3.3.
- Client mode through CFG80211 is supported from kernel regression 2.6.38 only.
- DFS Master through CFG80211 is supported for kernel versions greater than 3.11 only.
- Wi-Fi Direct Mode through CFG80211 is not supported.
- Roaming through CFG80211 is supported in kernels greater than 3.11 only.
- WOWLAN feature is supported in SDIO for kernels greater than 3.0 only.
- While scanning station in concurrent mode, stations connected to AP might disconnect.
- Wi-Fi Performance is less in dense environments.
- Wi-Fi 2G 40Mhz is not supported.
- Digital Loopback is not supported.
- PUF is not supported.
- 11j 40Mhz,10Mhz modes are not supported.
- 11p is not supported.
- AP mode more than 32 clients not supported, AP + BT + BLE has 4 clients support.
- CW Mode is not supported.
- RF Loopback modes M2, M3 are not supported.
- CCX & 11k not supported.
- USB ULP is not supported.
- iAP Apple Wi-Fi Home kit is not supported.
- PUF IID is not supported.
- WAPI is not supported.
- WDS is not supported.
- WMM-Admission Control is not supported.
- External 3-wire coexistence is not supported.
- LP Power save using GPIO handshake is not supported.

BT/BLE Recommendations

- In BLE, recommended range of Connection Interval in
  - Power Save - 100ms to 1.28sec.
  - BT Classic + BLE Dual Mode is >= 200ms.
  - Wi-Fi + BLE coex - 30ms to 4sec
- In BLE, during Connection, same values of Scan Interval and Scan Window is not recommended.
- In BT Classic, recommended value of Sniff Interval during Power Save is limited to 100ms (<= 100).
- In Wi-Fi + BT Classic coex, for BT file transfer to work fine, recommended value of Wi-Fi protocol DTIM is more than 3 and Beacon Interval is more than 200ms.

BT/BLE Limitations/Features Not Supported

17. BT Sniff mode does not work if BT multiple slaves feature is enabled
18. When BT multiple slaves feature is enabled, Master to slave role switch will not happen
19. In BLE, if Advertising/Scanning are in progress, and the device moves to Slave/Master role, Advertising/Scanning will be stopped. Provide respective commands to start Advertising/Scanning while being in Slave/Master role.
20. In Wi-Fi + BLE coex, if BLE Connection is established with small Connection Interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.
21. Observed glitches in BT audio in coex mode when Wi-Fi is connected
22. In BLE, if device is acting as Master/Slave, Scan Window (in set_scan_params and create_connection command) shall be less than the existing Connection Interval.
23. In BLE, if Advertising/Scanning are in progress, and the device moves to Slave/Master role, Advertising/Scanning will be stopped. Provide respective commands to start Advertising/Scanning while being in Slave/Master role.
24. In BLE, if BLE Connection is established with small Connection Interval (< 15ms), simultaneous roles (i.e. Master/Slave + Advertising/Scanning) are not supported.

Folder Structure Changes

-None-

Release Notes – RS911X.NBZ.NL.GNU.LNX.2.0.RC2_TR3

Date: Friday 22nd November 2020

Release Status

- Test   ☑
- Alpha   ☐
- Beta   ☐
- Production ☐

Supported Linux Kernel Versions:

- Kernel versions from 3.18 to 5.0

Firmware Versions:

- Release_GNU_1.2.99

Supported platforms:

- X86, IMX, Caracalla

Host Interfaces Supported:

- USB
- SDIO

New Features

Common

-None-

Wi-Fi

- Added support for STA->AP and AP->STA switching in coex mode

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Changes/Issues Fixed

Common

-None-

Wi-Fi

- Fix for RSI-STA connection issue while switching from RSI-AP to RSI-STA.
- Fixed WLAN authentication failure issue with 1.2.0 firmware.
- Limited BT-TX power in ETSI domain to 10dbm.

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

- Ble connection issues.

WLAN known bugs

- For UAPSD power save, packet retry is happening.

WLAN Limitations/Feature Not Supported

- For GTK rekey, wakeup trigger send to host.
- Maintain ~20 Sec delay and insert 2/3/4/5 module to use Multi mode feature.
- BGSCAN with RS-9116 module, By default it will take connected band channels only.

BT/BLE Limitations/Features Not Supported

- To connect multiple BT slaves, connection should be initiated from rsi module.
- In coex mode, BT file transfer fails at times with certain mobiles.

ZIGB Limitations/Features Not Supported

- Multimode support is not available for zigbee.

Folder Structure Changes

-None-

Release Notes – RS911X.NBZ.NL.GNU.LNX.2.0.RC1

Date: Friday 16th November 2018

Release Status

- Test ☑
- Alpha ☐
- Beta ☐
- Production ☐

Supported Linux Kernel Versions:

- Kernel versions from 3.18 to 4.19.0.rc7

Firmware Versions:

- Release_GNU_1.1.0f(RS9116)
- Release_GNU_1.6.1(RS9113)

Supported platforms:

- X86, IMX, Caracalla

Change log v2.0:

- Since RS9113 releases are in 1.X series, Changing common releases to 2.x release.

Host Interfaces Supported:

- USB
- SDIO

New Features

Common

-None-

Wi-Fi

-None-

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

-None-

Changes/Issues Fixed

Common

-None-

Wi-Fi

- Fix for RSI-STA connection issue while switching from RSI-AP to RSI-STA.
- Fixed WLAN authentication failure issue with 1.2.0 firmware.
- Limited BT-TX power in ETSI domain to 10dbm.

Bluetooth - Common

-None-

Bluetooth – Classic

-None-

Bluetooth – LE

- Ble connection issues.

WLAN known bugs

- For UAPSD power save, packet retry will happend.
- For QoS, Driver will only send BE in all the cases.

WLAN Limitations/Feature Not Supported

- For GTK rekey, wakeup trigger send to host.
- Maintain ~20 Sec delay and insert 2/3/4/5 module to use Multi mode feature.
- BGSCAN with RS-9116 module, By default it will take connected band channels only.

BT/BLE Limitations/Features Not Supported

- To connect multiple BT slaves, connection should be initiated from rsi module.
- In coex mode, BT file transfer fails at times with certain mobiles.

ZIGB Limitations/Features Not Supported

-None-

Folder Structure Changes

-None-

Legal

Disclaimer

Silicon Labs intends to provide customers with the latest, accurate, and in-depth documentation of all peripherals and modules available for system and software implementers using or intending to use the Silicon Labs products. Characterization data, available modules and peripherals, memory sizes and memory addresses refer to each specific device, and "Typical" parameters provided can and do vary in different applications.

Application examples described herein are for illustrative purposes only.

Silicon Labs reserves the right to make changes without further notice and limitation to product information, specifications, and descriptions herein, and does not give warranties as to the accuracy or completeness of the included information. Silicon Labs shall have no liability for the consequences of use of the information supplied herein. This document does not imply or express copyright licenses granted hereunder to design or fabricate any integrated circuits. The products are not designed or authorized to be used within any Life Support System without the specific written consent of Silicon Labs. A "Life Support System" is any product or system intended to support or sustain life and/or health, which, if it fails, can be reasonably expected to result in significant personal injury or death. Silicon Labs products are not designed or authorized for military applications. Silicon Labs products shall under no circumstances be used in weapons of mass destruction including (but not limited to) nuclear, biological or chemical weapons, or missiles capable of delivering such weapons.

Trademark Information

Silicon Laboratories Inc.® , Silicon Laboratories®, Silicon Labs®, SiLabs® and the Silicon Labs logo®, Bluegiga®, Bluegiga Logo®, Clockbuilder®, CMEMS®, DSPLL®, EFM®, EFM32®, EFR, Ember®, Energy Micro, Energy Micro logo and combinations thereof, "the world's most energy friendly microcontrollers", Ember®, EZLink®, EZRadio®, EZRadioPRO®, Gecko®, ISOmodem®, Micrium, Precision32®, ProSLIC®, Simplicity Studio®, SiPHY®, Telegesis, the Telegesis Logo®, USBXpress®, Zentri, Z-Wave and others are trademarks or registered trademarks of Silicon Labs.

ARM, CORTEX, Cortex-M3 and THUMB are trademarks or registered trademarks of ARM Holdings.

Keil is a registered trademark of ARM Limited. All other products or brand names mentioned herein are trademarks of their respective holders.