# AN1276: RS9113 to RS9116 Migration Guide

Version 1.3

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# 1 Introduction

This guide provides hardware and software migration information from RS9113 to RS9116 modules. It covers the migration of the modules with and without antenna. Features, performance, and power numbers of the RS9116 modules are different from the corresponding RS9113 modules. The corresponding datasheets should be used for more information. Table 1 provides a mapping from the RS9113 module to corresponding footprint compatible module in the RS9116.

**Note:** This document is for Single-Band modules only. There is currently no footprint compatibility for RS9113 Dual-Band modules.

**Table 1: RS9113 to RS9116 Module Mapping**

| RS9113 Module | Footprint Compatible RS9116 Module |
|---|---|
| **n-Link™ Hosted Modules** | |
| RS9113-NXX-S0N | RS9116N-SXX0-AA0-ABC |
| RS9113-NXX-S1N | RS9116N-SXX0-AA1-ABC |
| **Connect-io-n™ Embedded Modules** | |
| RS9113-NXX-S0C | RS9116W-SXX0-AA0-ABC |
| RS9113-NXX-S1C | RS9116W-SXX0-AA1-ABC |
| **WiSeConnect™ Embedded Modules** | |
| RS9113-NXX-S0W | RS9116W-SXX0-AA0-ABC |
| RS9113-NXX-S1W | RS9116W-SXX0-AA1-ABC |

"XX" in RS9113 part numbers can be replaced with the following options:

- "00": No BT or ZigBee
- "B0": Bluetooth

"XX" in RS9116 part numbers can be replaced with the following options:

- "00": No BT or ZigBee/Thread
- "B0": Bluetooth

"ABC" in RS9116 part numbers represent Silicon revision and firmware version.

- A: Silicon revision ("X" – 1.3; "B" – 1.4; "C" – 1.5)
- BC: Firmware version ("24" – version 1.2.24; "2A" – version 2.0, etc.)

## 2   Migration of RS9113 Modules without Antenna

This section applies to the following n-Link, Connection, and WiSeConnect modules (without antenna) of RS9113:

- RS9113-NXX-S0N (corresponding RS9116 part number: RS9116N-SXX0-AA0-ABC)

- RS9113-NXX-S0C (corresponding RS9116 part number: RS9116W-SXX0-AA0-ABC)

- RS9113-NXX-S0W (corresponding RS9116 part number: RS9116W-SXX0-AA0-ABC)

**Table 2: Migration of Modules without Antenna**

| SN | Description (Pin Names in RS9113 Data Sheet) | Modification Required in the RS9116 Design |
|---|---|---|
| H.1 | Pins 15 (USB_VDDD) and 23 (USB_VDDS) are no connects in RS9116. | No modification is required. |
| H.2 | Pin 41 (BOOTLOAD_EN) is no connect in RS9116. | No modification is required. |
| H.3 | Pin 40 (BOOTMODE_0) is no connect in RS9116. This pin was used for host bus selection in RS9113 which is detected automatically in RS9116. | No modification is required. |
| H.4 | Pin 60 (HOST_SEL_0) is no connect in RS9116. This pin was used for host bus selection in RS9113 which is detected automatically in RS9116. | No modification is required. |
| H.5 | Pin 55 (HOST_SEL_1) is no connect in RS9116. This pin was used for host bus selection in RS9113 which is detected automatically in RS9116. | No modification is required. |
| H.6 | Pin 80 (SDIO_DATA3) is connected to ground directly for USB/USB-CDC modes. | No modification required if USB-CDC mode is used. However, if USB mode is required, then, the pin needs to be left unconnected. |
| H.7 | Pin 80(SDIO_DATA3) is connected to ground though a 51k resistor for UART mode. | No modification is required. |
| H.8 | Pin 10 (GPIO_2/HOST_WAKEUP) is used as a handshake signal for waking up the host in UART mode. | The HOST_WAKEUP functionality has been combined with BT_PRIORITY (Pin 82). Pin 82 was named in RS9113 as GPIO_18/ BT_PRIORITY and its name in RS9116 is UART2_CTS/HOST_WAKEUP/ BT_PRIROTY. Pin 10 has been converted to I2C_SDA. The HOST_WAKEUP functionality is not required if the host can wake up (to receive packets from the module) based on the SDIO or SPI interrupts or if flow control pins (RTS/CTS) of UART are used to control the data flow. |
| H.9 | Pins 69 (JP0), 70 (JP1) and 96 (JP2) need pull-down resistors. | Pull-down resistors should be removed to avoid current leakage. |

**Note**: Please refer to Section 4 for software migration.

# 3   Migration of RS9113 Modules with Antenna

This section applies to the following n-Link, Connection, and WiSeConnect modules (with antenna) of RS9113:

- RS9113-NXX-S1N (corresponding RS9116 part number: RS9116N-SXX0-AA1-ABC)

- RS9113-NXX-S1C (corresponding RS9116 part number: RS9116W-SXX0-AA1-ABC)

- RS9113-NXX-S1W (corresponding RS9116 part number: RS9116W-SXX0-AA1-ABC)

### Table 3: Migration of Modules with Antenna

| SN | Description (Pin Names in RS9113 Data Sheet) | Modification Required in the RS9116 Design |
|---|---|---|
| H.1 | Pins 42 (USB_VDDD) and 22 (USB_VDDS) are no connects in RS9116. | No modification is required. |
| H.2 | Pin 27 (BOOTLOAD_EN) is no connect in RS9116. | No modification is required. |
| H.3 | Pin 20 (BOOTMODE_0) is no connect in RS9116. This pin was used for host bus selection I RS9113 which is detected automatically in RS9116. | No modification is required. |
| H.4 | Pin 36 (HOST_SEL_0) is no connect in RS9116. This pin was used for host bus selection in RS9113 which is detected automatically in RS9116. | No modification is required. |
| H.5 | Pin 35 (HOST_SEL_1) is no connect in RS9116. This pin was used for host bus selection in RS9113 which is detected automatically in RS9116. | No modification is required. |
| H.6 | Pin 15 (SDIO_DATA3) is connected to ground directly for USB/USB-CDC modes. | No modification required if USB-CDC mode is used. However, if USB mode is required, then, the pin needs to be left unconnected. |
| H.7 | Pin 15(SDIO_DATA3) is connected to ground though a 51k resistor for UART mode. | No modification is required. |
| H.8 | Pin 26 (GPIO_2/HOST_WAKEUP) is used as a handshake signal for waking up the host in UART mode. | The HOST_WAKEUP functionality has been combined with BT_PRIORITY (Pin 30). Pin 30 was named in RS9113 as GPIO_18/ BT_PRIORITY and its name in RS9116 is UART2_CTS/HOST_WAKEUP/ BT_PRIROTY. Pin 26 has been converted to I2C_SDA. The HOST_WAKEUP functionality is not required if the host can wake up (to receive packets from the module) based on the SDIO or SPI interrupts or if flow control pins (RTS/CTS) of UART are used to control the data flow. |
| H.9 | Pins 45 (JP2), 47 (JP0) and 48 (JP1) need pull-down resistors. | Pull-down resistors should be removed to avoid current leakage. |

# 4   Software Migration from RS9113 to RS9116

## 4.1   n-Link™ Modules

This section applies to the software migration of all n-Link modules, which include the following:

- RS9113-NXX-S0N (corresponding RS9116 part number: RS9116N-SXX0-AA0-ABC)

- RS9113-NXX-S1N (corresponding RS9116 part number: RS9116N-SXX0-AA1-ABC)

No changes are required at the application level to migrate from the RS9113 n-Link to the RS9116 n-Link. However, a new version of the driver (with a different firmware) needs to be used for the RS9116. Migrating to the RS9116 driver is the same as upgrading to a new RS9113 driver – no additional changes are required.

The drivers for RS9116 are available on the Silicon Labs website under [Software and Tools](Software and Tools).

## 4.2   Connect-io-n™ and WiSeConnect™ Modules

This section applies to the software migration of all Connect-io-n and WiSeConnect modules, which include the following:

- RS9113-NXX-S0C (corresponding RS9116 part number: RS9116W-SXX0-AA0-ABC)

- RS9113-NXX-S1C (corresponding RS9116 part number: RS9116W-SXX0-AA1-ABC)

- RS9113-NXX-S0W (corresponding RS9116 part number: RS9116W-SXX0-AA0-ABC)

- RS9113-NXX-S1W (corresponding RS9116 part number: RS9116W-SXX0-AA1-ABC)

### 4.2.1 Host Interface Detection Changes

The RS9116 supports auto host interface detection due to which some changes are required in the application to initialize the host interface.

#### 4.2.1.1   Auto Baud Rate Detection in UART

In the RS9113, if auto baud rate is not initiated from the host, the module defaults to 115200 bps after a timeout. In the RS9116, the bootloader waits until auto baud rate is initiated if host interface is UART. For USB-CDC, auto baud rate detection is mandatory for both RS9113 and RS9116.

#### 4.2.1.2   USB Host Enumeration

There are some differences in the parameters used during the USB enumeration process in RS9113 and RS9116. These differences are listed below.

**Table 4: USB Enumeration**

| Description | RS9113 | RS9116 |
|---|---|---|
| Product ID | 9113 | 9116 |
| No of endpoints | 2 | 3 |
| Headroom for WLAN Management and Data packets | 236 bytes | 256 bytes |
| Headroom for BT/BLE Management and Data packets | 0 bytes | 128 bytes |

#### 4.2.1.3   SPI Host Bus Initialization

In the RS9116, the host needs to send 0x00124A5C pattern to the module for SPI bus initialization (this pattern was 0x15 in the RS9113). If the initialization is successful, the module sends 0x58 to the host. If it is a failure, it sends 0x54 (SPI busy) or 0x52 (SPI failure). The same initialization sequence is required (sending pattern 0x00124A5C instead of 0x15) on ULP wakeup.

### 4.2.2 Bootloader Menu Changes

In the RS9116, host interface register size has been increased from 16 bits (in RS9113) to 32 bits. The additional bits are used for new features supported in the RS9116 and do not impact the RS9113 backward compatibility.

Due to the changes in the bootloader menu, the user application may need changes (if bootloader bypass option is not used) to parse/skip the menu string. The following images provide details on the differences between the RS9113 and the RS9116 bootloader menus.
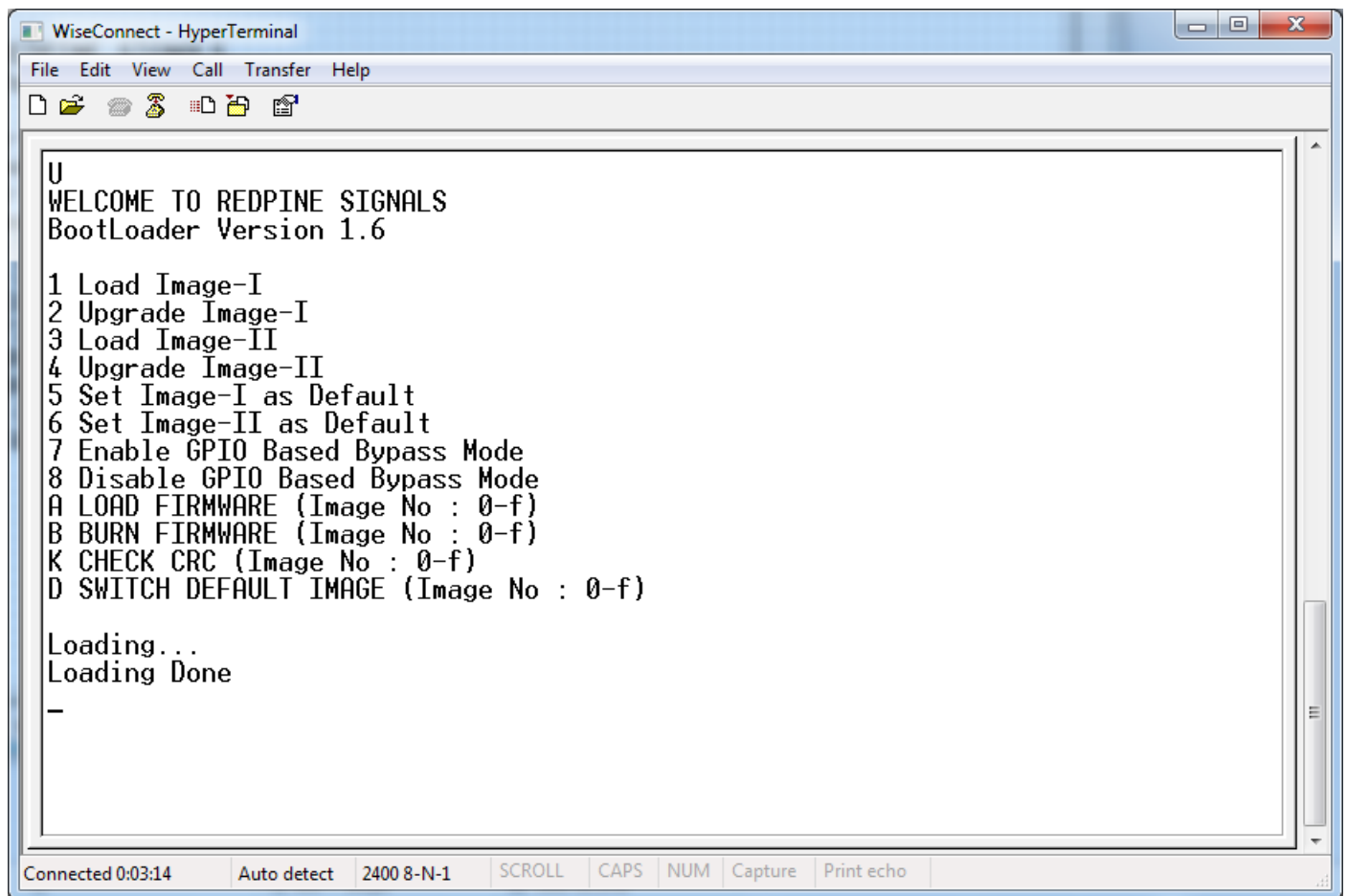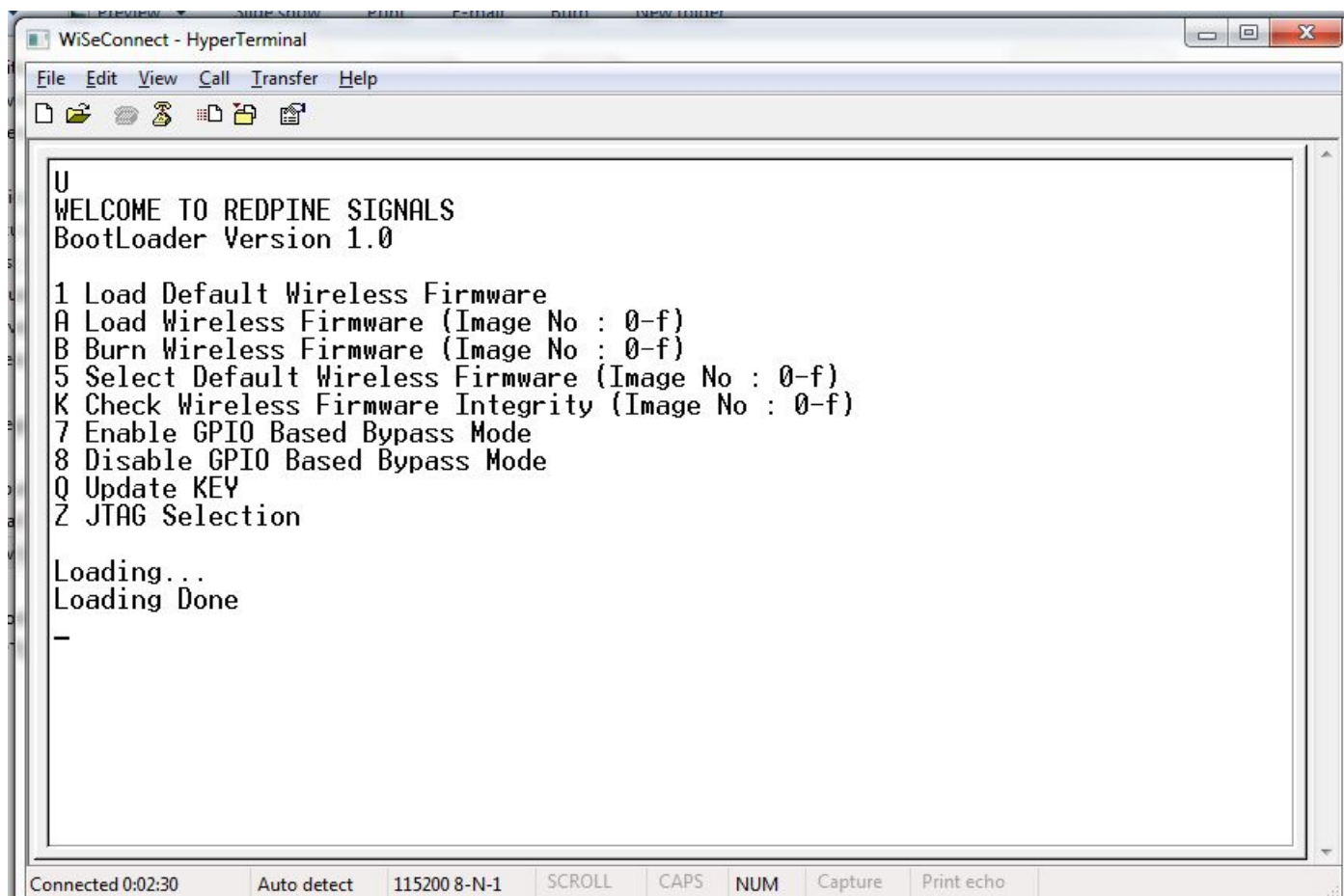


**Figure 1: RS9113 Bootloader Menu**

**Figure 2: RS9116 Bootloader Menu**

## 4.2.3 Bootloader Operation Changes

To accommodate new features in the RS9116, some changes have been done in the bootloader operations. Some of these require change in the application software when migrating from RS9113 to RS9116.

**Table 5: Bootloader Operation Changes**

| SN | Operation | Description | Modification Required in RS9116 Software |
|----|-----------|-------------|------------------------------------------|
| S.1 | Loading Image | Three different image load options are present in the RS9113:<br><br>1. Load Image1<br><br>2. Load Image2<br><br>3. Load Image (0-f)<br><br>"Load image2" has been removed in the RS9116. | Since there is a single firmware image for multiple modes of operation, "Load Image2" is not required. It has no impact on the user application. |
| S.2 | Upgrade Image | Three different image upgrade options are present in the RS9113:<br><br>1. Upgrade Image-1<br><br>2. Upgrade Image-2<br><br>3. Burn Firmware (0-f)<br><br>"Upgrade Image-1" & "Upgrade Image-2" options have been removed in the RS9116. | User will need to change the firmware upgrade utility (select firmware upgrade option "B" and image number to upgrade – it is usually "0"). |

| SN | Operation | Description | Modification Required in RS9116 Software |
|---|---|---|---|
| | | Ping/Pong buffer addresses are different between RS9113 and RS9116.<br><br>RS9113<br><br>• Ping Address: 0x19000<br><br>• Pong Address: 0x1A000<br><br>RS9116<br><br>• Ping Address: 0x18000<br><br>• Pong Address: 0x19000 | User will need to change the firmware upgrade utility with the new ping/pong addresses. |
| | | RPS file format header size has been increased from 32 bytes to 64 bytes | Change will be required in firmware upgrade utility. |
| S.3 | Set Default Image | Three different sets of default image options are present in the RS9113:<br><br>1. Set Image-1<br><br>2. Set Image-2<br><br>3. Switch Default Image (0-f)<br><br>"Set Image-1 & Set Image-2" options have been removed in the RS9116.<br><br>Default image option "D" in RS9113 has been changed to "5" in the RS9116. | It is a configuration option. So, changes will be required in user manufacturing flow. |
| S.4 | Enable/Disable GPIO bypass | In the RS9116, along with GPIO bypass enable, the user needs to specify the host interface to be used as GPIO bypass enable also bypasses auto host detection. Using UART/UCB-CDC, the user can specify the host interface to be used in the next bootup cycle in GPIO bypass mode. | It is a configuration option. So, changes will be required in the user manufacturing software. The RS9116 provides flexibility to select a different host interface in the next bootup cycle in the host interface bypass mode. |
| S.5 | Reconfiguration enable/disable | RS9113<br><br>• Reconfiguration enable: 'E'<br><br>• Reconfiguration disable: 'H'<br><br>RS9116<br><br>• Reconfiguration enable: 'C'<br><br>• Reconfiguration disable: 'D' | It is a configuration option. So, changes may be required in the user manufacturing software. |
| S.6 | Binary mode enable/disable | RS9113<br><br>• Enable Binary mode: 'L'<br><br>• Disable Binary mode: 'M'<br><br>RS9116<br><br>• Enable Binary mode: 'H'<br><br>• Disable Binary mode: 'U' | The application may require changes to enable/disable binary mode configuration. |
| S.7 | Bootloader version | RS9116 bootloader version is 1.0 | The RS9113 and RS9116 firmware versions are different. |

Please refer to the software manuals of RS9113 and RS9116 for details on each of the options.

## 4.2.4 Functional Firmware Changes

### 4.2.4.1 Feature Frame Changes
Feature frame is a new command added in the RS9116 to select different hardware features. This optional command must be sent before the init command to enable external RF for dual band operation.

**Note**: Feature frame is required to be sent to select Lower Power chain for optimal power numbers. For more details about this frame, please refer to the WiSeConnect programming reference manuals available in RS9116 Document Library.

### 4.2.4.2 BT / BLE feature bit map changes in operation mode (opermode) command
The BT feature frame has been changed from the 9113 to the 9116 in the operation mode command to accommodate new features.

The 9113 has one feature bit map of 32 bits for both BT and BL. The following is a list of the bit map:

| Bits | Feature |
| --- | --- |
| 0 – 7 | BLE number of attributes |
| 8 – 11 | BLE number of GATT services |
| 12 – 15 | BLE number of slaves |

The 9116 has two feature bit maps – one for BT features and another one for BLE features. Each of the bit maps are 32 bits. The following is a brief list of the two-bit maps:

**RS9116 BT feature bitmap:**

| Bits | Feature |
| --- | --- |
| 0 – 29 | Reserved |
| 30 | RF type (internal – 1/external – 0) |
| 31 | Reserved |

**RS9116 BLE feature bitmap:**

| Bits | Feature |
| --- | --- |
| 0 – 7 | BLE number of attributes |
| 8 – 11 | BLE number of GATT services |
| 12 – 15 | BLE number of slaves |
| 16 – 23 | BLE Tx powersave index |
| 24 – 26 | BLE powersave options |
| 27 – 31 | Reserved |

**Note**: For more details about BT and BLE feature bit maps, please refer to the WiSeConnect BT and BLE programming reference manuals available in RS9116 Document Library.
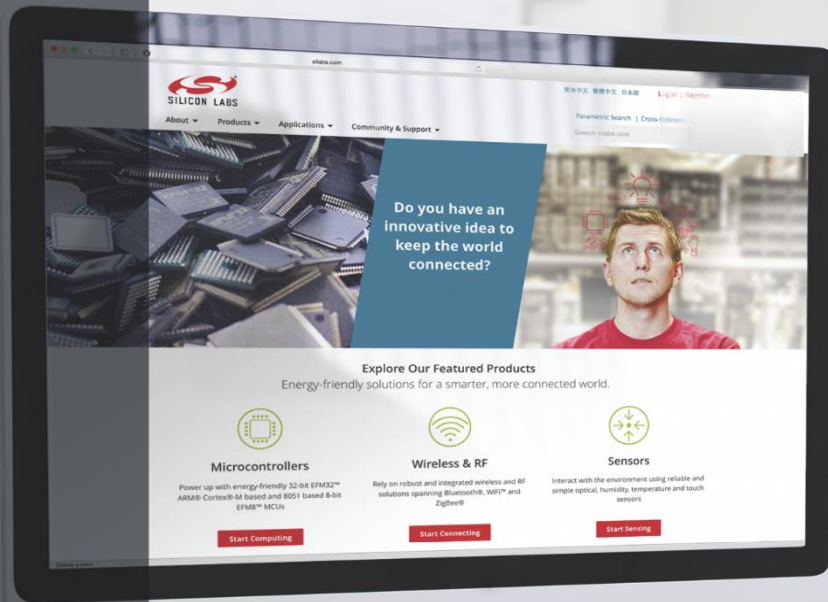
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