RSL10

Bluetooth® 5 Radio SoC Family

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Public Information

ON

Presentation Overview – Key Sections

1 Bluetooth Low Energy – Background and Technology

2 RSL10 Bluetooth 5 Radio SoC Family Overview

3 RSL10 Key Technical Features and Competitive Product Comparisons

4 RSL10 Software Development Kit – Rapid End Application Development

5 RSL10 Success Stories

**6** RSL10 SDK Web Download and Third Party (DSP) Tools Ordering Information

7 RSL10 EVKs

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Module 1

Bluetooth Low Energy – Background and Technology

What is Bluetooth Low Energy (BLE)?

RSL10

- Bluetooth Low Energy (BLE) is an energy-saving variant of the Bluetooth Personal Area Network standard

- BLE works with much smaller data packages compared to Bluetooth Classic

- BLE comes with an ever growing set of profiles to ensure interoperability (typically between a phone and an application)

- BLE is synonymous with small size, long battery life and ease of deployment

- BLE was previously known as Bluetooth Smart

- BLE Operates in the 2.4 GHz WW ISM band
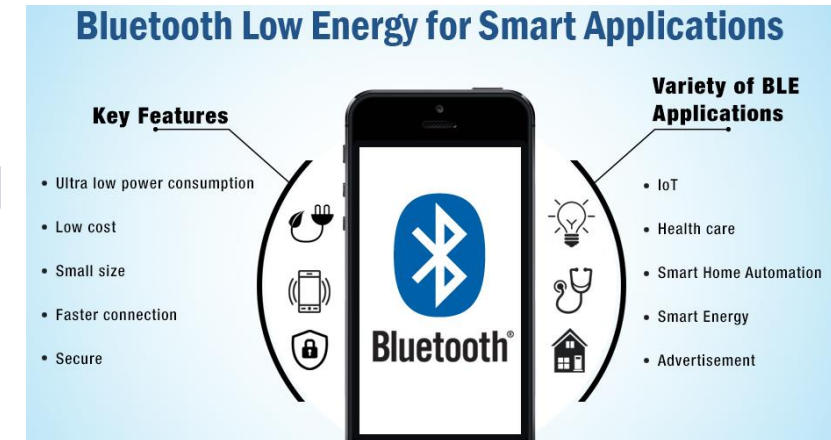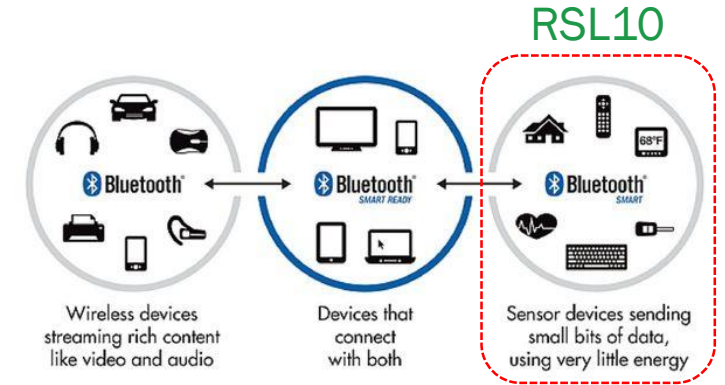
RSL10 is Bluetooth Low Energy only and does not support Bluetooth Classic

Module 2

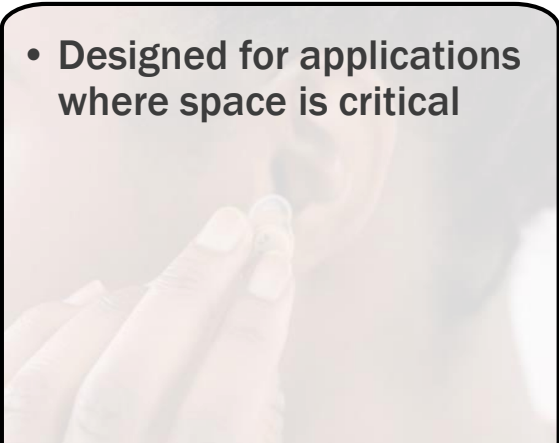RSL10 Bluetooth 5 Radio SoC Family Overview

RSL10 Product Family

Packages for any application!

- Qualified for consumer and medical applications
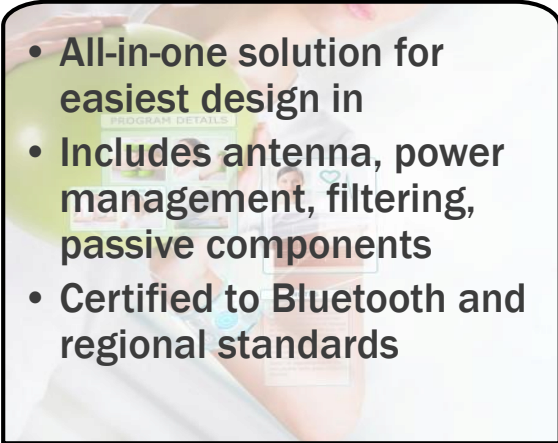
QFN
6x6

- Designed for applications where space is critical

WLCSP
2.3x2.3

- All-in-one solution for easiest design in
- Includes antenna, power management, filtering, passive components
- Certified to Bluetooth and regional standards
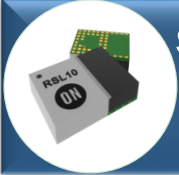
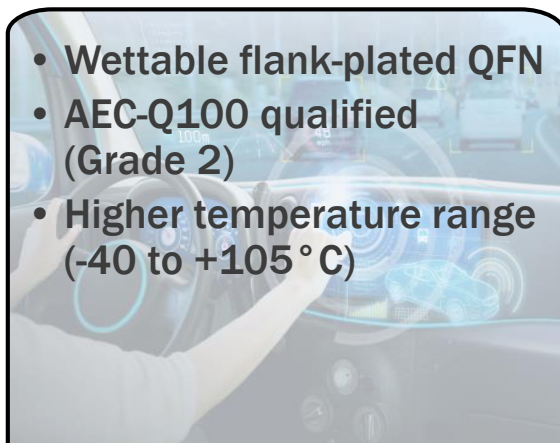**System-in-Package (SiP)**
6x8

- Wettable flank-plated QFN
- AEC-Q100 qualified (Grade 2)
- Higher temperature range (-40 to +105°C)

Automotive QFN
7x7

RSL10 SiP

Ultra-Low Power Bluetooth Low Energy with Easier Design In!

Ultra-small complete solution
- Includes antenna, all discrete components and crystals
- Compact (6mm x 8mm) BLE hardware solution for any application

Ultra-low power consumption of RSL10
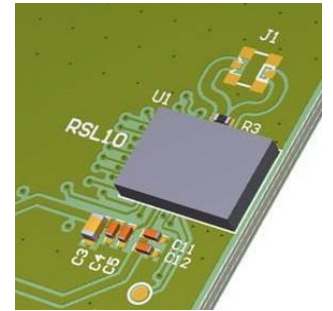- Industry's lowest power consumption

Easy Design-in
- No RF design expertise required to integrate
- Simply drop on to your PCB

6 mm x 8 mm

Pre-Certified to regional standards, saving time and money
- Bluetooth SIG
- Regulatory Certifications:

FCC (U.S.)	CE (Europe)	IC (Canada)
MIC (Japan)	KCC (Korea)	

Public Information

NCV-RSL10

RSL10 for Automotive
It's About the Journey, Not the Destination
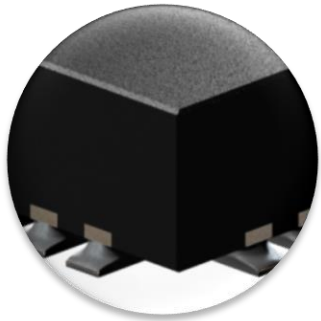
Reliable Assembly (stronger, more visible solder joints)

Automotive-Qualified

Higher Temperature Range (Automotive Grade 2)

Comprehensive Software Development Kit

Module 3

RSL10 Key Technical Features and Competitive Product Comparisons

Key Specifications

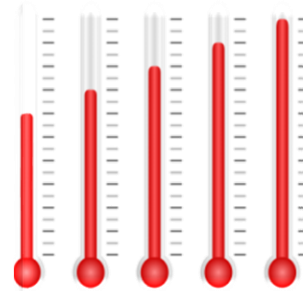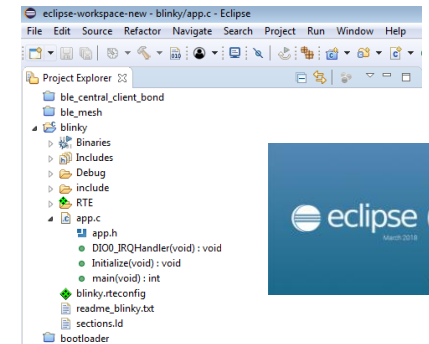*RSL10 is designed for lowest power consumption across a wide range of power supply voltages*

Industry's Lowest Power

- 1090 EEMBC® ULPMark™ CP @ 3V
- 3mA Rx peak current (-94dBm) @ 3V
- 4.6mA Tx peak current (0dBm) @ 3V
- 25nA deep sleep current @ 3V
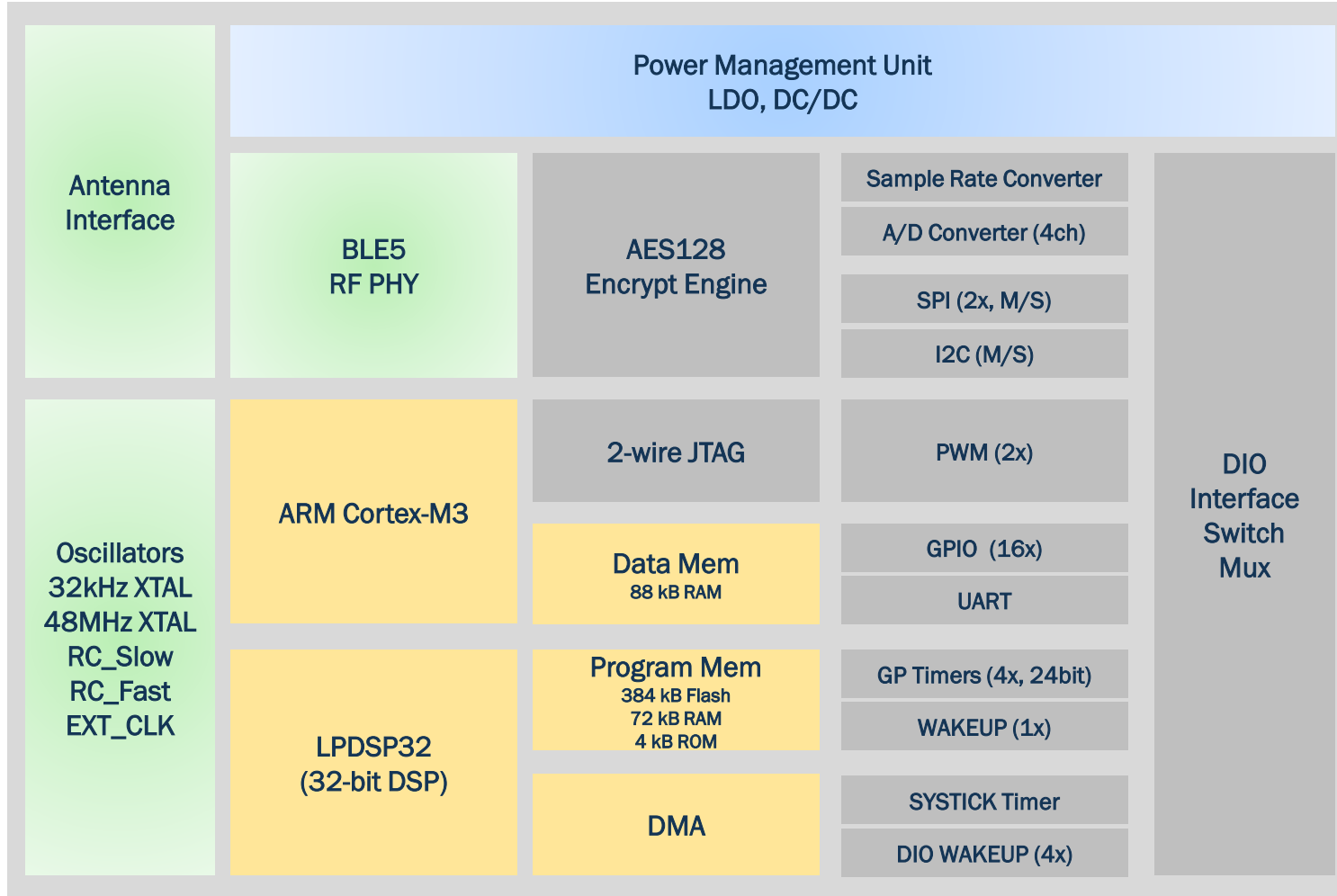
Advanced Wireless

- Supports Bluetooth Low Energy
- Supports 2.4 GHz custom protocols
- -94 dBm Rx Sensitivity (WLCSP/QFN)
- -17 to +6 dBm Tx power (WLCSP/QFN)

Flexible, Powerful Radio SoC

- Voltage supply range 1.1 to 3.3 V
- User-Programmable Dual-core (Cortex-M3 / DSP) Architecture
- Firmware Over The Air (FOTA)

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Inside RSL10

RSL10 Block Diagram

Antenna Interface	**Power Management Unit** LDO, DC/DC
	BLE5 RF PHY — **AES128 Encrypt Engine** — Sample Rate Converter / A/D Converter (4ch) / SPI (2x, M/S) / I2C (M/S)
Oscillators 32kHz XTAL 48MHz XTAL RC_Slow RC_Fast EXT_CLK	**ARM Cortex-M3** — 2-wire JTAG — Data Mem 88 kB RAM — PWM (2x) / GPIO (16x) / UART — DIO Interface Switch Mux
	LPDSP32 (32-bit DSP) — Program Mem 384 kB Flash 72 kB RAM 4 kB ROM — DMA — GP Timers (4x, 24bit) / WAKEUP (1x) / SYSTICK Timer / DIO WAKEUP (4x)

RSL10 Key Attribute

- BLE5 2MBit/s data rate
- Internal RF balun
- Built-in PMU (1.1V-3.3V VBAT)
- Security (JTAG lock, AES128)
- Built-in 32-bit DSP

Customer Benefit

- **Faster** firmware over the air (FOTA) upgrades
- **Less Rx/Tx time** => reduced power

- **Reduced** number of ext. components
- **Reduced overall BoM cost**

- **Reduced overall BoM cost**
- **Optimized** for lowest power consumption

- **Secure** FOTA upgrades
- **No unauthorized access** to proprietary source code

- Supports audio codec implementations for custom 2.4 GHz audio protocols

Public Information

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RSL10 Current Consumption – Most Common Customer Question

Question:

"If I Tx-advertise on 3-channels (standard BLE advertisement) once every second what is my overall power consumption and battery life time?"

Answer:

- Figure 1 shows the measured advertising current consumption profile from a 3V battery source
- Figure 2 shows a zoomed view of a single advertising event
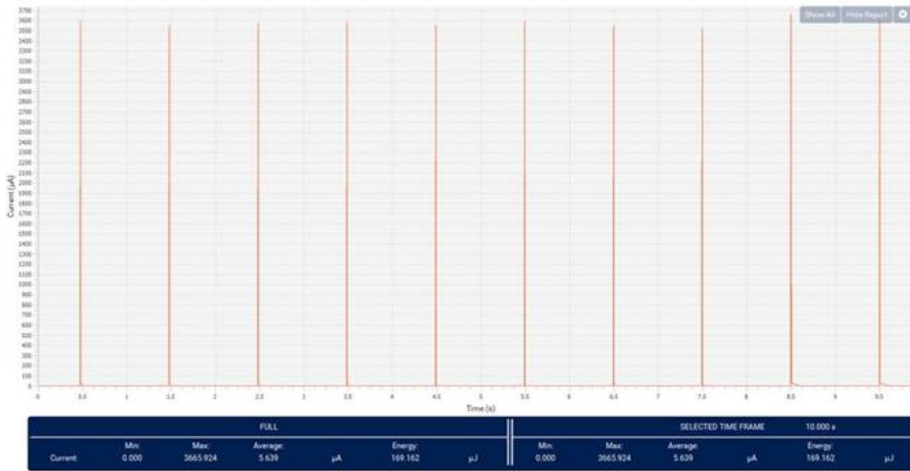- Table 1 shows the key calculated numbers to answer the question
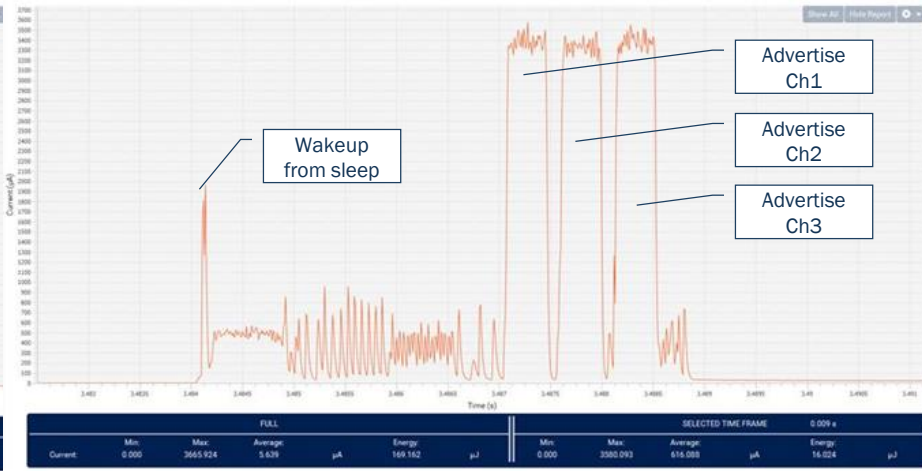
Figure 1

Figure 2

Table 1

Specification	Parameter
2032 Battery Capacity	200mAh
Average advertising current	5uA
Total battery life time	40,000 hours or ~4.5 years!

- **1 Tx advertising event per second**
- **Average current of ~5μA (3V battery source)**

- **Single advertising event snapshot**
- **Peak Tx Current (3V battery source) of 3.5mA**
- **20μJ for entire packet (3V, battery source 3 channels per BLE standard)**

Public Information

Module 4

RSL10 Software Development Kit – Rapid End Application Development

RSL10
Development Tools Overview

RSL10 Software Development Kit (SDK)

Enables rapid development of ultra-low power Bluetooth Low Energy applications by leveraging convenient abstraction, drivers and sample applications from Blinky to complete BLE peripherals, and everything in between

- Key features:

  - Eclipse-based ON Semiconductor IDE plus support for Keil and IAR

  - Complete Bluetooth Low Energy protocol stack

  - Bluetooth Low Energy mesh with Android app

  - Secure FOTA (Firmware Over The Air) with Android and iOS app

  - FreeRTOS

  - Synopsys LPDSP32 development tools

- Development hardware:

  - RSL10 QFN and SiP Evaluation boards

  - RSL10 USB Dongle
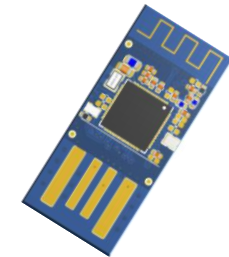
| ON Semiconductor IDE | KEIL | IAR |
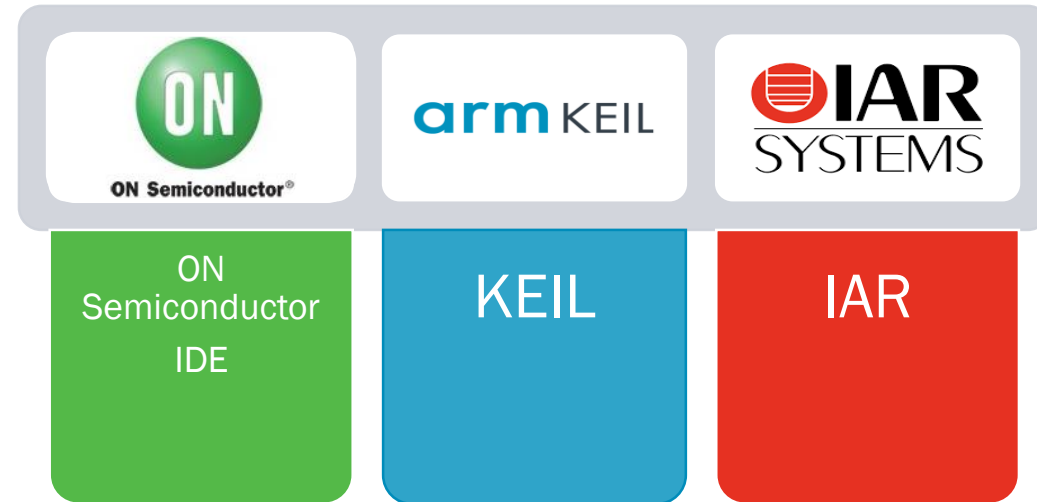
RSL10 QFN

RSL10 SiP

RSL10 USB Dongle

Public Information

Sample Code and Profiles

BLE Profiles

- **Bluetooth Low Energy Samples**

  - Central/Client and Peripheral/Server roles

  - Use of low power modes to maximize power efficiency

  - BLE 5 features - 2 Mbps data rate and Data Length Extension (DLE)

  - High-level APIs to speed development and low-level APIs for flexibility

- **Microcontroller Peripheral Samples**

  - CMSIS compliant drivers (UART, SPI, I2C, etc)

  - Low-level system functions to optimize performance

- **Utility Samples**

  - Secure FOTA (Firmware Over The Air)

  - UART based bootloader

Heart Rate

Proximity

Health Thermometer

Time

Blood Pressure

Glucose Monitor

HID over GATT (HOG)

Alert Notification

Phone Alert Status

Running Speed

Cycling Speed

Cycling Power

Location and Navigation

Rezence (Wireless Charging)

Continuous Glucose Monitoring

RSL10
Software Stack-up with CMSIS-Packs
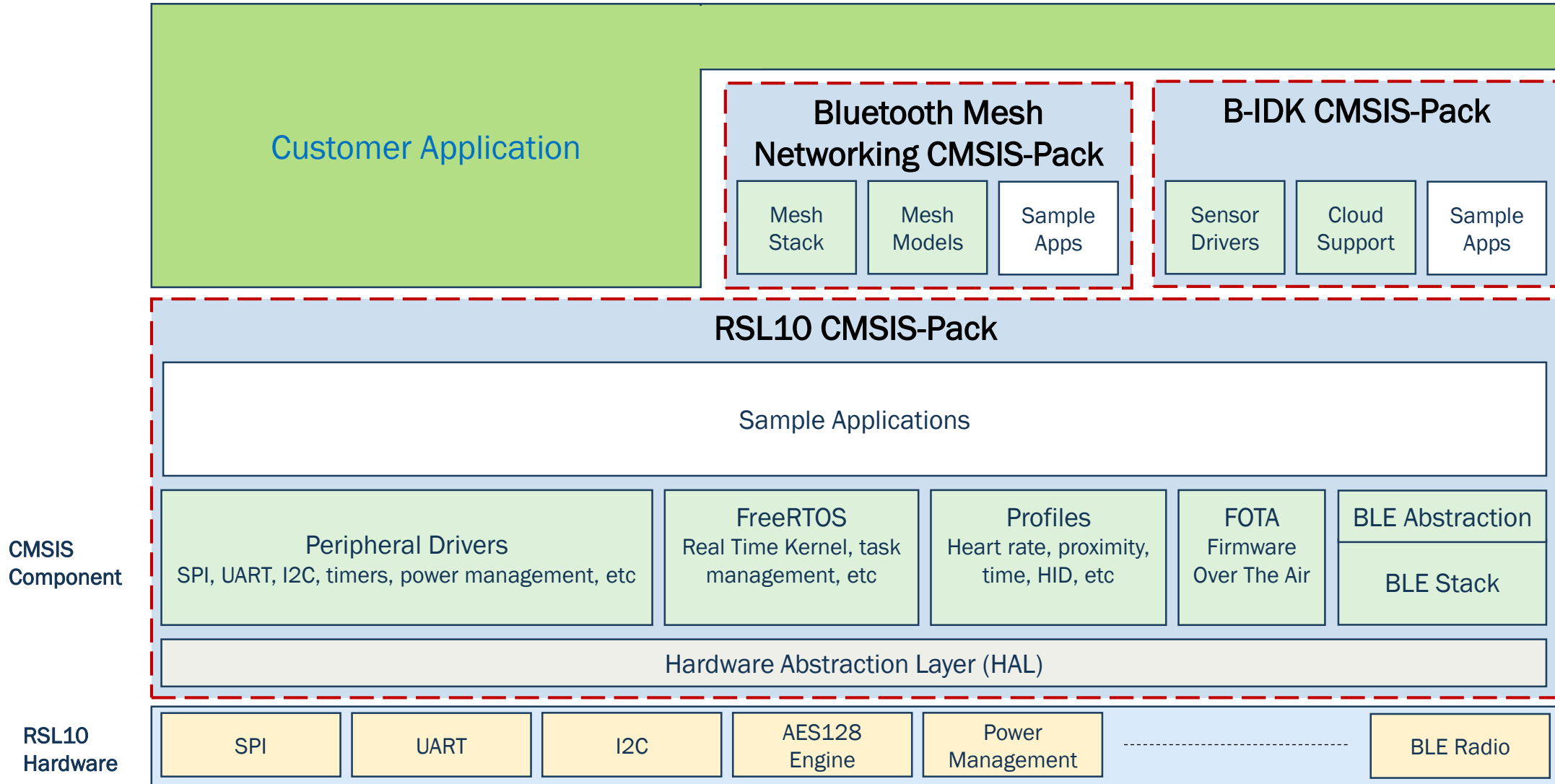
HID Demo – Getting Started with RSL10 SDK

The Peripheral Server HID Demo demonstrates:

- Ease of getting up and running with the RSL10 Software Development Kit
- Functionality of a wireless input device (keyboard) by making use of the BLE HID OVER GATT Profile (HOGP)
- Transmitting keyboard strokes from the wireless input device (RSL10 evaluation board) for display on host (cellphone)
- Range of available code samples

How to get started:

- Follow the instructions in the Getting Started Guide install the SDK and become familiar with the IDE and CMSIS-Pack manager
- Import and build the *peripheral_server_hid* sample project
- Use the flash loader to load the HID demo onto the RSL10 development board

Try the HID Demo Application

- Using your smartphone Bluetooth search for *ONSemi_Keyboard* and pair with it
- After pairing, the LED on the evaluation board with be solid and no longer blink
- Load an app such as Notepad, Word, Chrome, or Safari
- Repeatedly press the momentary switch on the eval board (not the reset button) and your phone will display "RSL10 ON Semiconductor HID Keyboard Demo"

Public Information

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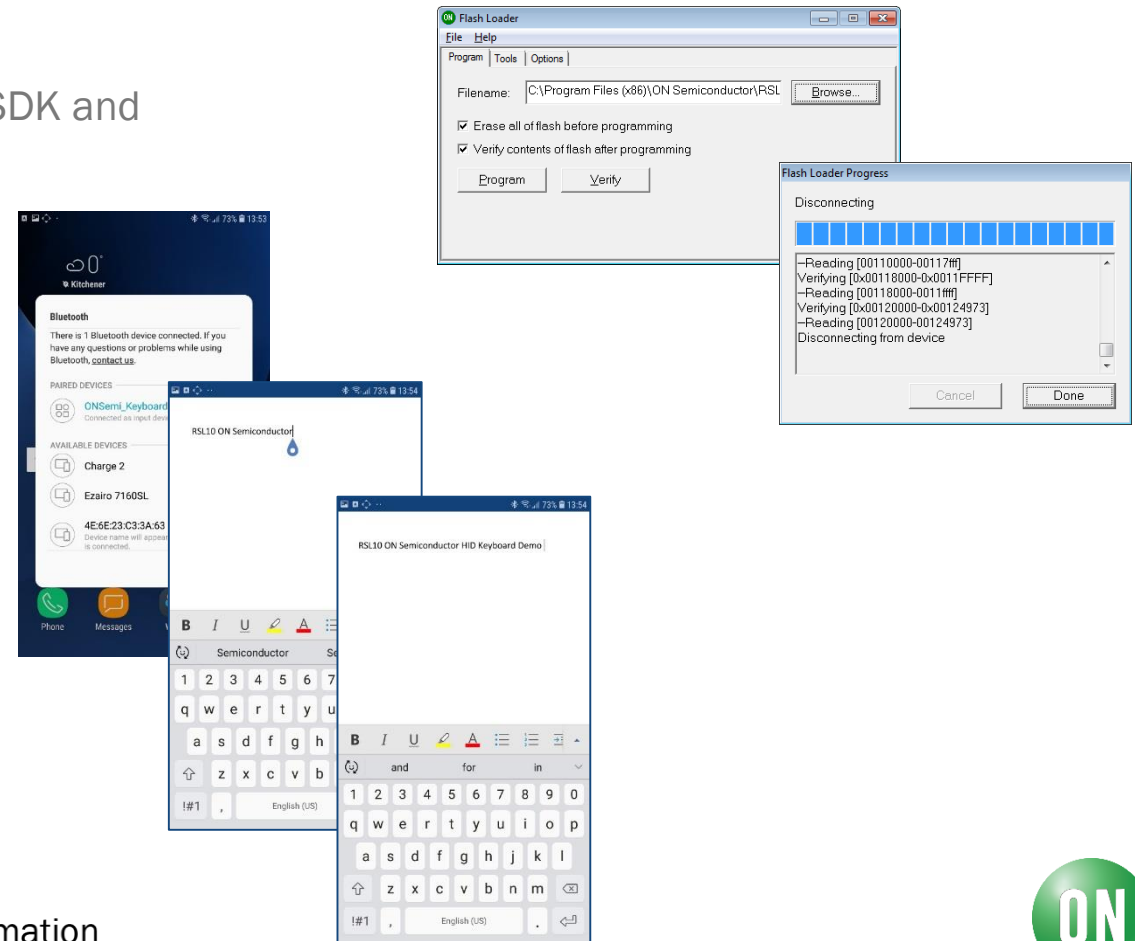
Module 5

RSL10 Success Stories

Energy Harvesting Light Control

Challenge

Ultra-low power wireless solution capable of operating <u>without battery or wall power</u> for lighting control
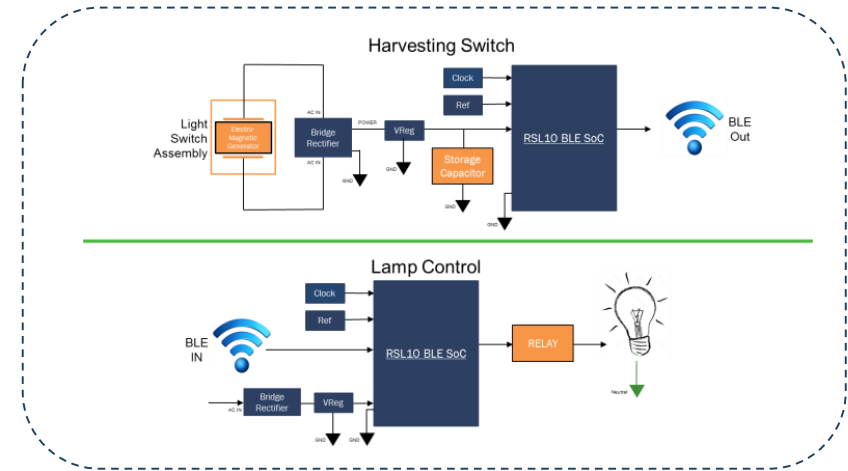
ON Semiconductor Solution

- RSL10 (Bluetooth 5 certified radio SoC)
- Ultra-low-power operation enables sufficient energy harvesting from switch piezo element
- 4-5 advertising packets generated and sent to BLE receiver on light bulb to turn light on or off
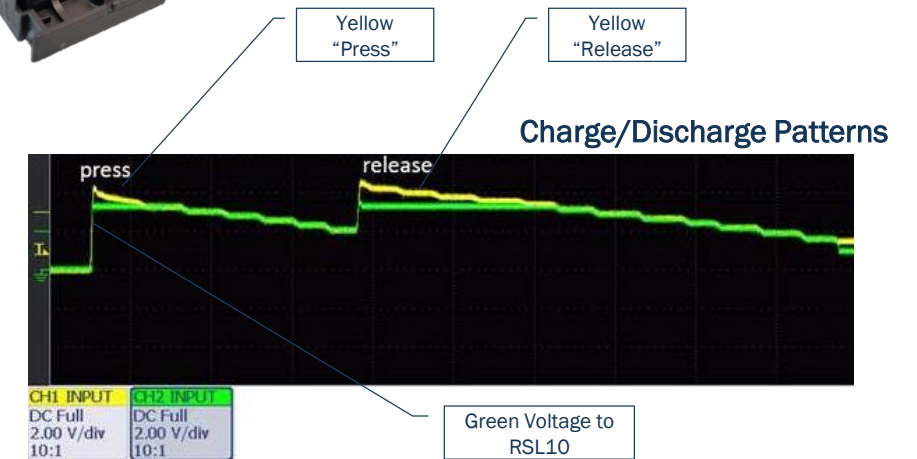
Customer Benefits

- Switch can be placed anywhere without battery or wall power
- Eliminates need for hardwiring from switch to light in 'add-on' application, reducing labor and hardware costs (Aluminum or Copper Wiring)
- Allows for smartphone control

End-customer Solution

Mechanical Design

Yellow "Press"

Yellow "Release"

Charge/Discharge Patterns

Green Voltage to RSL10

Hearables

End-customer Solution

Challenge

Develop a 2.4 GHz based hearable that enables audio streaming while maintaining multi-day battery life time
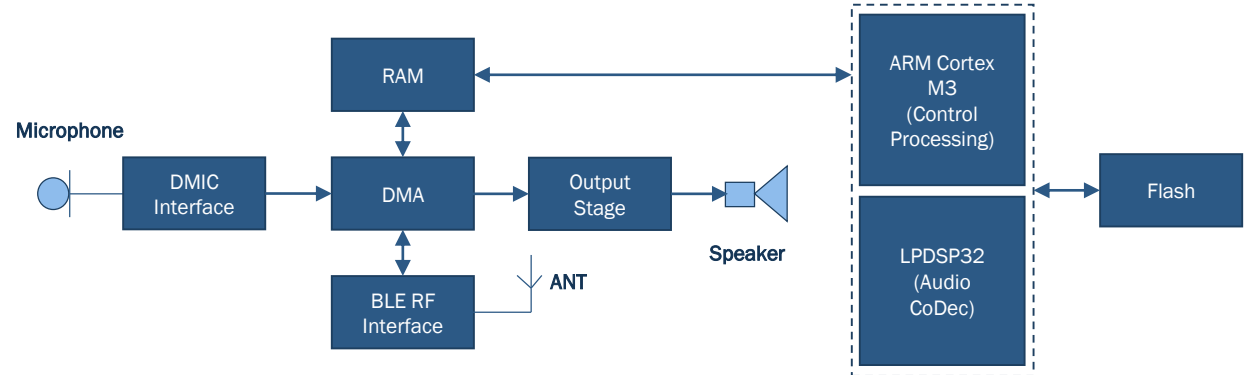
ON Semiconductor Solution

- RSL10 (Bluetooth 5 certified radio SoC)

  – Single chip solution with RSL10

  – Cortex M3 used for control processing and BLE stack

  – LPDSP32 used for Audio Codec (G.722) and audio processing

Customer Benefits

- On-chip DSP and Audio I/O makes single-chip solution possible

- Small package (WLCSP51) enables in-ear, cosmetically appealing hearables

Diagram blocks: Microphone → DMIC Interface → DMA → Output Stage → Speaker; RAM; BLE RF Interface → ANT; ARM Cortex M3 (Control Processing); LPDSP32 (Audio CoDec); Flash

A hearable is a wireless in-ear computational earpiece. Essentially you have a micro computer that fits in your ear canal and utilizes wireless technology to supplement and enhance your listening experience.

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E-Tags

What is it?

A tag that shows price and product information

Value Advantage

Price and product information can be changed centrally – no need to manually change individual price tags

Target Applications

Anywhere that requires pricing information – shopping malls, supermarkets ...

Scenario:

1. Customer can read, get the detail by APP;
2. Admin modifies the display information;
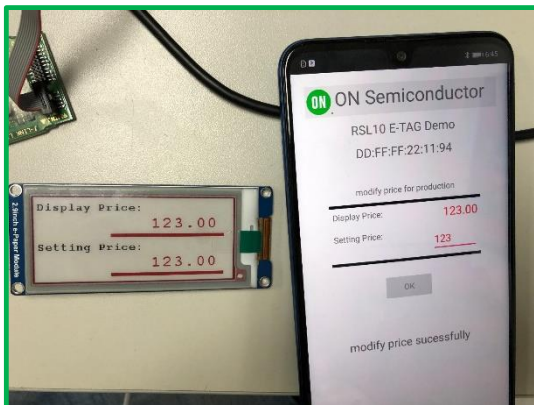
Power Meter

China State Grid has released a BLE standard for new E-meter applications. ON Semi assisted with the development of the E-meter solution.

The new BLE e-meter application:
- Uses BLE solution to replace the old Infrared and 485-interface
- Uses BLE wireless solution for the E-meter Test Bench
- BLE Switch along with the E-meter
- BLE Collector for the Host

E-meter*N Slave

Host   Host

Test Bench

E-meter*N Slave

Mobile Phone Host

Host

Public Information
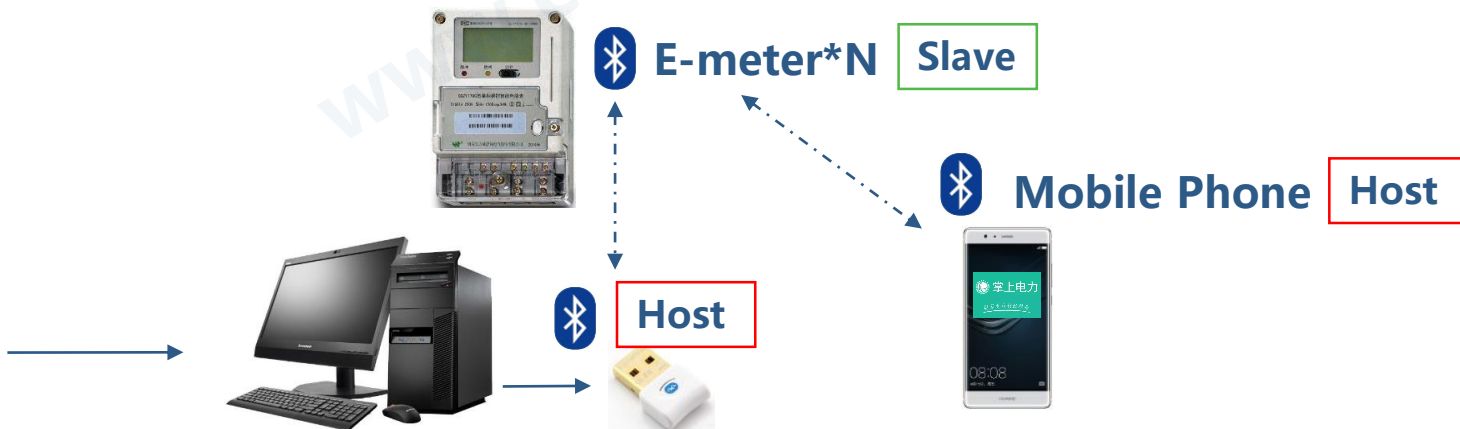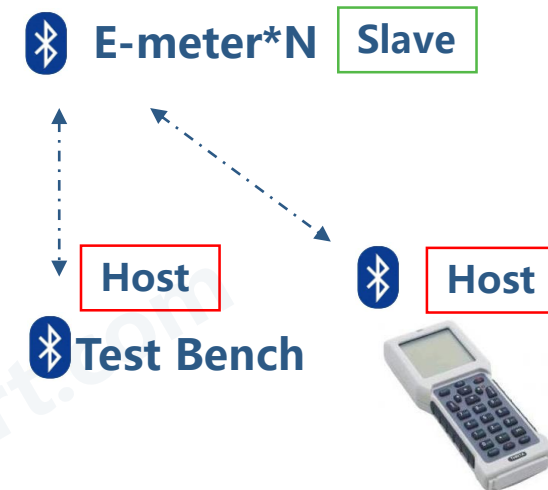
Module 6

RSL10 SDK Web Download and Third–Party (DSP) Tools Ordering Information

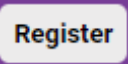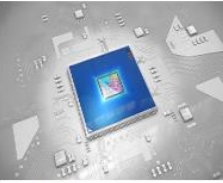# SDK Download Information and 3rd Party Tools Ordering

RSL10 SDK From ON Semi Website

1. Go to the RSL10 page at www.onsemi.com/rsl10

2. Use the download buttons on the main page ----> Download

3. Download and read 'RSL10 Getting Started Guide' for detailed instructions

4. Download and install the 'ON Semiconductor IDE Installer'

5. Download and unzip the 'RSL10 Software Package' which contains the RSL10 CMSIS-Pack

6. Follow instructions in the 'RSL10 Getting Started Guide' to install the CMSIS-Pack and sample projects

7. Other optional downloads available such as 'RSL10 Bluetooth Mesh Package'

Check back regularly for updates!

Note: MyON account required to download locked files, create account here

LPDSP32 C-Compiler 30 Day Evaluation from Synopsys

1. Go to https://eval.synopsys.com/

2. Register for Synopsys Eval Portal account -------→ Register

3. Log into Synopsys Eval Portal account ------→ Log in

4. Select product line ASIP Programmer ---------→

ASIP Programmer
Software Development Kits (SDK) for Application - Specific Instruction-set Processors (ASIPs)

5. Select product LPDSP32 -------------→

LDPSP32 Programmer
30-Day Evaluation License
ASIP Owner:
ON Semiconductor®
View Details

6. Request evaluation license from Synopsys

7. Synopsys will email instructions to download and install the requested tools

Note: Ensure 'HostID' provided is from your PC and not from a docking station

Contact Synopsys sales asip_sales@synopsys.com to purchase (ex: 1 year node locked license US$3,800)
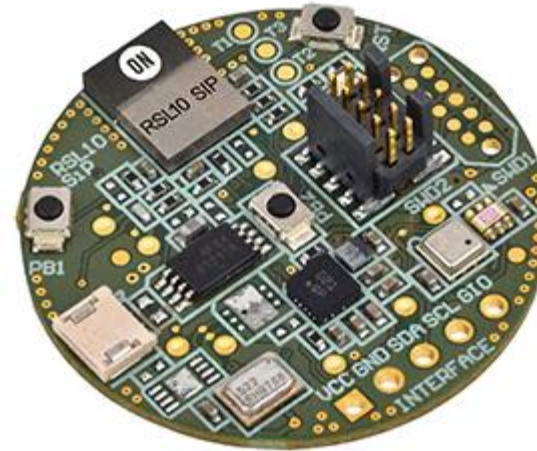
Module 7

RSL10 EVKs

RSL10 EVKs

RSL10 QFN

rsl10-coin-gevb

rsl10-sense-db-gevk

rsl10-sense-gevk

https://www.onsemi.cn/support/evaluation-board/rsl10-002gevb
https://www.onsemi.cn/support/evaluation-board/rsl10-coin-gevb
https://www.onsemi.cn/support/evaluation-board/rsl10-sense-db-gevk

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