# EVE2 BLE Ethernet
Datasheet

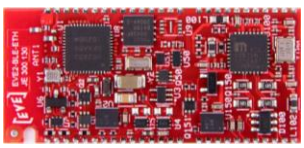
## Main features

**Software**

- Micro-kernel with scheduling, power and clock management
- Contiki OS
- Tickless design
- Drivers for peripherals
- Bluetooth® 4.1 compliant low energy single-mode protocol stack
- BLE Central and Peripheral side
- NFC
- Remote software upgrade
- Ethernet drivers and protocols
- TCP using Berkeley socket interface
- UDP
- HTTP and HTTPS

**Hardware**

- 32-bits Cortex M4 microcontroller from Nordic Semiconductor
- Up to 64MHz CPU speed
- 512 kbytes program FLASH
- 64 kbytes RAM
- 8 Mbytes serial FLASH
- 19 I/O including ADC, Comparators, SPI, UART, I²C, PWM etc.
- Runs from 1.9V-3.6V battery voltage and 5V
- Built-in 3.3V voltage regulator
- Built-in power source selector
- Extreme low power consumption
- Ethernet controller
- 18 x 40 x 3.0 mm



*EVE2 BLE Ethernet module – actual size*

## General description

The EVE Platform is an integrated hardware and software platform solution engineered to provide a robust and flexible base for individual product development. Implementing EVE in new products fast-tracks the design process to a detail-design level and reduces the overall cost and time-to-market.

The EVE Platform features standardized IO, common OS and drivers and ultra-low power consumption.

All EVE modules provide full operation capabilities from an APP at smartphones, tablet etc. via BLE (Bluetooth Low Energy). System configuration, firmware upgrade, service functions and log and data reading are easy to do from an APP via BLE.

## Ethernet description

The Ethernet physical and data link layer gives support for the higher level network protocols provided by the extended uIP TCP/IP stack.

The EVE2 BLE Ethernet supports 10BASE-T (10Mbit/s) and 100BASE-TX (100Mbit/s) connection and 2 outputs for LED indication.

The HTTP(S) server can be used to implement homepages for product configuration, control and maintenance.

## Applications

- Industrial control
- Security
- Measurement & data acquisition
- Residences and hotels
- Fire alarm systems
- Medical & Healthcare
- Telecom
- Ship & Offshore
- Yachts
- Recreation
- Consumer electronic

# CONTENTS

# 1 EVE PLATFORM INTRODUCTION

## 1.1 For all modules

The EVE Platform is a robust, flexible and cost-effective technological platform for a wide range of electronic products and industries. The EVE Platform has been developed and engineered by industry professionals using proven technology and high quality components. All modules are fully tested and certified before delivery, eliminating the need for additional time or cost outlays.

The EVE Platform is designed for optimal integration and fulfills the common technical requirements for product development. All EVE modules are engineered with standardized IO, common OS and drivers, with focus on ultra-low power consumption.

The EVE modules are using the same core functionality and technology, and are differentiated by the communication carrier system they use.

The following features are identical for all EVE modules:

- 19 I/O (ADC, Comparators, SPI, UART, I²C, PWM etc.)
- Pinout
- Ultra-low power microcontroller
- BLE
- NFC
- OS, drivers and development environments
- Filesystem

## 1.2 Ethernet

The EVE Ethernet module uses KSZ8851SNL integrated MAC and PHY device from Microchip which perfectly covers use-cases where embedded TCP/IP connectivity is required. The platform utilizes a uIP software stack which is also extended to Berkeley socket interface. Extremely small footprint and robustness of the extended stack opens a possibility to develop quite complex applications on top of the stack.

Power consumption is still in the focus. Since the power consumption of the Ethernet PHY in active state can be close to 100 mA, the whole connectivity part of the module can be turned off to save power. The solution reduces system power consumption in idle state back to the µA range.

One of the important use-cases for Ethernet connectivity is the so-called “product homepage”, a small embedded website hosted by the product and responsible for plug-and-play product configuration and maintenance. The EVE Platform provides complete infrastructure, including an embedded web server, mDNS, DHCP servers, and a micro-website suitable for most applications.

The platform uses mbed TLS (formerly known as PolarSSL) for cryptographic purposes, providing support for safe connectivity solution development.

# 2 ELECTRICAL CHARACTERISTICS

## 2.1 General part

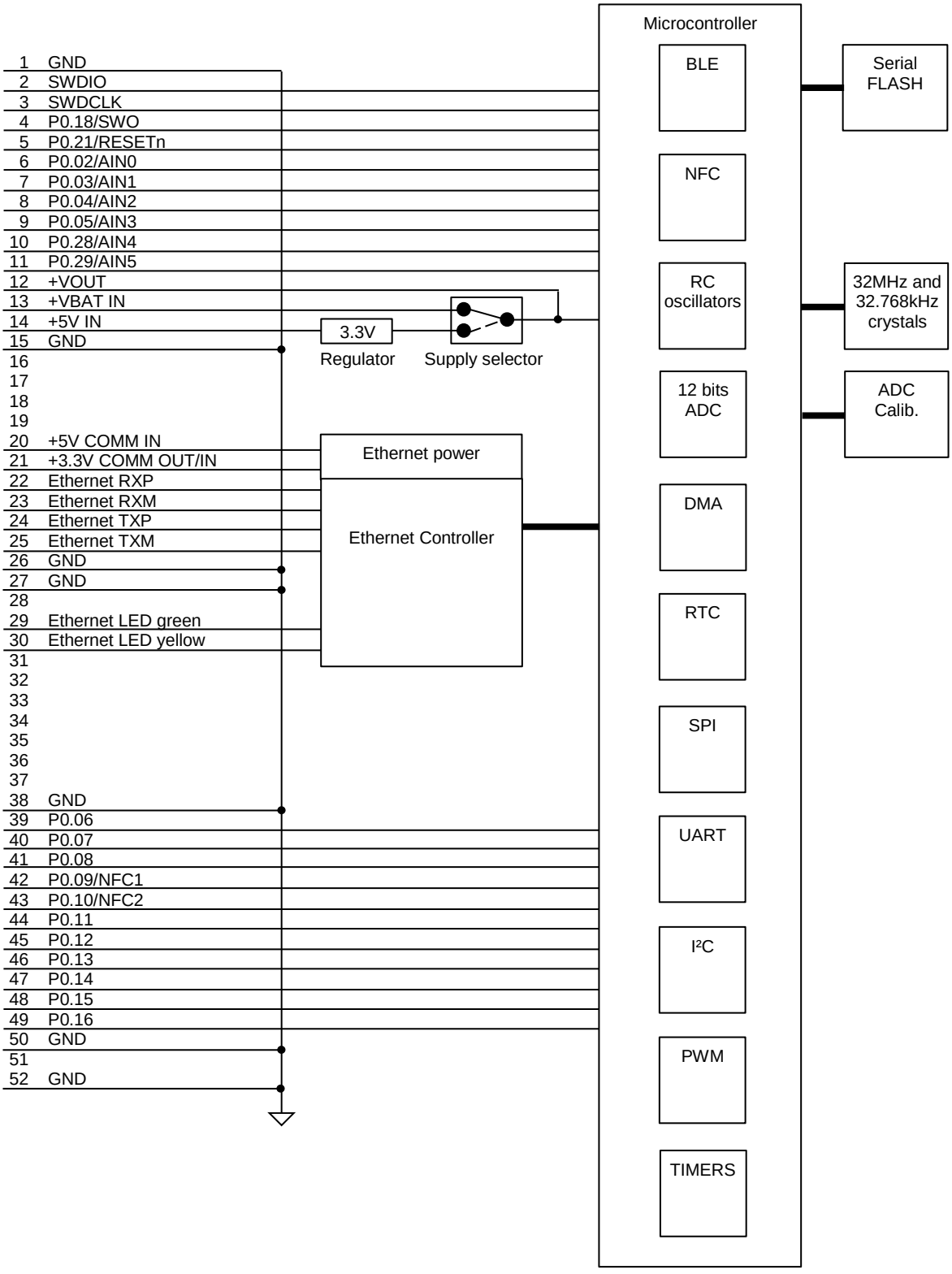
| Parameter | Value |
|---|---|
| Supply voltage +VBAT IN | 1.9 V – 3.6 V |
| Supply voltage +5V IN | 2.7 V – 5.5 V |
| Supply voltage +5V IN if VOUT = 3.3V is required | 3.6 V – 5.5 V |
| Temperature range | -40 °C to +85 °C |
| Current consumption +VBAT IN (typical): | |
| • Power down | 1 µA |
| • Idle + RTC | 3 µA |
| • BLE advertising 1/sec | 20 µA |
| • BLE connected;  10msec interval, slave latency=0 | 400 µA |
| • BLE connected;  10msec interval, slave latency=49 | 18 µA |
| • BLE connected; 100msec interval, slave latency=0 | 50 µA |
| • BLE connected; 100msec interval, slave latency=4 | 18 µA |
| • BLE connected; 200msec interval, slave latency=0 | 30 µA |
| • BLE connected; 500msec interval, slave latency=0 | 18 µA |
| • “While (1)” loop | 3 mA |
| Current consumption +5V IN (typical): | |
| • Power down | 110 µA |
| • BLE advertising 1/sec | 130 µA |
| IO output current capacity selection L / H (typical @ 1.9V) | 2 / 2 mA |
| IO output current capacity selection L / H (typical @ 2.7V) | 10 / 9 mA |

## 2.2 Ethernet part

| Parameter | Value |
|---|---|
| Supply voltage +5V COMM IN | 4.5 V – 5.5 V |
| Supply voltage +3.3V COMM IN | 3.1 V – 3.5 V |
| Current consumption (typical): | |
| • 100BASE-TX Operation | 85 mA |
| • 10BASE-T Operation | 75 mA |
| • Power Saving Mode | 70 mA |
| • Soft Power Down Mode | 2 mA |
| • Energy Detect Mode | 2 mA |

# 3 BLOCK DIAGRAM

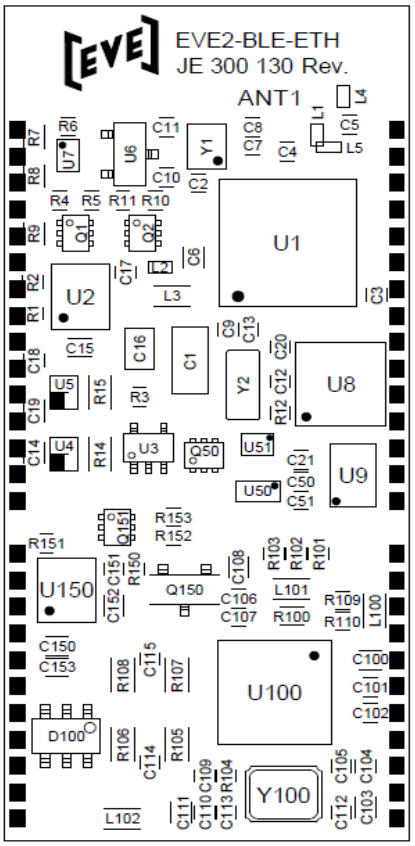
The block diagram shows edge connector number, power blocks, microcontroller, memory, Ethernet power/contoller and wiring.



# 4 IO DESCRIPTION

## 4.1 Pinout

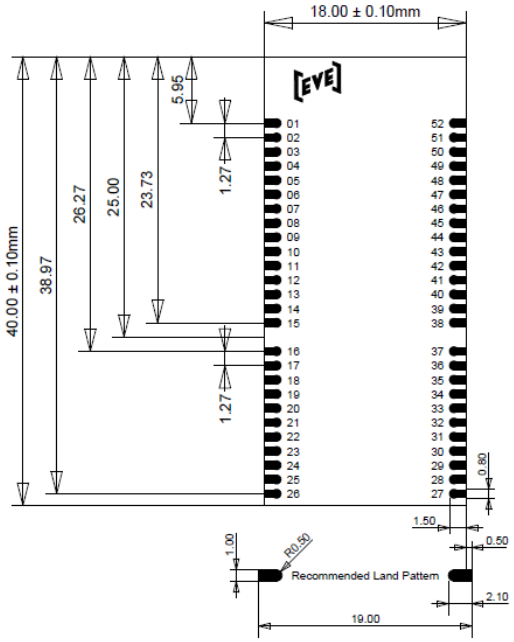
| Function | Pin | | Pin | |
|---|---|---|---|---|
| GND | 1 | | 52 | GND |
| SWDIO | 2 | | 51 | (Reserved BLE antenna) |
| SWDCLK | 3 | | 50 | GND |
| SWO/P0.18 | 4 | | 49 | P0.16 |
| RESETn/P0.21 | 5 | | 48 | P0.15 |
| AIN0/P0.02 | 6 | | 47 | P0.14 |
| AIN1/P0.03 | 7 | | 46 | P0.13 |
| AIN2/P0.04 | 8 | | 45 | P0.12 |
| AIN3/P0.05 | 9 | | 44 | P0.11 |
| AIN4/P0.28 | 10 | | 43 | P0.10/NFC2 |
| AIN5/P0.29 | 11 | | 42 | P0.09/NFC1 |
| +VOUT | 12 | | 41 | P0.08 |
| +VBAT IN | 13 | | 40 | P0.07 |
| +5V IN | 14 | | 39 | P0.06 |
| GND | 15 | | 38 | GND |
| (Reserved USB VBUS) | 16 | | 37 | (Reserved UART RTS / CAN STBY) |
| (Reserved USB DM) | 17 | | 36 | (Reserved UART TX out / CAN TX out) |
| (Reserved USB DP) | 18 | | 35 | (Reserved UART RX in / CAN RX in) |
| (Reserved USB ID) | 19 | | 34 | (Reserved RS485 RX out / CAN drv) |
| +5V COMM IN | 20 | | 33 | (Reserved RS485 TX in / CAN drv TX) |
| +3.3V COMM OUT/IN | 21 | | 32 | (Reserved RS485 B / CANH) |
| Ethernet RXP | 22 | | 31 | (Reserved RS485 A / CANL) |
| Ethernet RXM | 23 | | 30 | Ethernet LED yellow |
| Ethernet TXP | 24 | | 29 | Ethernet LED green/GND |
| Ethernet TXM | 25 | | 28 | (Reserved RF antenna) |
| GND | 26 | | 27 | GND |




Common for all modules

Module specific IO

## 4.2 Module ouline and recommended land pattern



# 5 HARDWARE DESCRIPTION

## 5.1 For all modules

The following information is applicable for the common part of all EVE modules.

### 5.1.1 Microcontroller

The EVE module are based on the microcontroller nRF52832 from Nordic Semiconductor which includes 512 kbytes program FLASH and 64kbytes RAM.

### 5.1.2 Serial FLASH

The modules contains 8 Mbytes serial flash.
A part of the serial FLASH is used for firmware upgrades, log data etc. The rest of the serial FLASH is available for use by the application software.

### 5.1.3 Power

#### 5.1.3.1 Battery supply

The EVE module can operate from battery voltage connected to the +VBAT IN terminal. The supply voltage is monitored by the module.

#### 5.1.3.2 +5V supply

The EVE module can operate from 5V connected to the +5V IN terminal. The supply voltage is regulated to 3.3V. Valid 3.3V is monitored by the module.

#### 5.1.3.3 Supply voltage selector

The terminal +5V IN is selected to supply the module while valid voltage from the 3.3V regulator. If the regulator voltage is too low, the +VBAT IN will automatically be selected. The selected voltage is available at the terminal +VOUT.

## 5.2 Ethernet

### 5.2.1 Ethernet Controller

The device used as Ethernet controller is KSZ8851SNL from Microchip.

### 5.2.2 Power

The Ethernet controller at the EVE module can operate from 5V connected to the +5V COMM IN terminal. The supply voltage is regulated to 3.3V. Valid 3.3V is monitored by the module. The regulated voltage is available at the terminal +3.3V COMM OUT/IN.

The Ethernet controller can also be powered from external 3.3V regulator at terminal +3.3V COMM OUT/IN. In this case the terminal +5V COMM IN must be connected to 0V.

# 6 FUNCTION DESCRIPTION

## 6.1 For all modules

The following functional description is common for the EVE Platform.

### 6.1.1 Micro-kernel

The software shipped with the EVE Platform implements a tiny and yet powerful micro-kernel, which provides basic system functionality such as:

- System clock, power and watchdog management
- Scheduling and delayed execution using workitems in µs and ms range
- Tickless system timer
- Drivers for EVE peripheral
- Built-in bootloader with in-circuit firmware upgrade functionality
- SWD debug print channel
- BLE
- NFC

### 6.1.2 OS

The EVE Platform are intended for Contiki OS environment. Contiki is a minimalistic OS, which has been designed, developed and maintained mainly by Adam Dunkels and Swedish Institute of Computer Science during the last 10 years under BSD license.

Contiki provides non-preemptive multitasking concept using protothreads, a type of lightweight stackless threads designed for severely memory constrained systems. Protothreads provides linear code execution for event-driven systems implemented in C.

In addition to multitasking and protothreads Contiki core provides synchronization primitives, event timers, static, pooled and dynamic memory allocation, as well as a lot of other primitives. EVE extends Contiki with functionality, provided by the micro-kernel, microwork scheduling and tickless design.

Contiki implements a file system (CoffeeFS), which can be rolled out on FLASH media with relatively small footprint. EVE provides external FLASH drivers and glue layer for the file system.

Contiki also provides a set of off-the-shelf applications which can be used as building blocks for products. The main focus within the set is communication protocols and stacks.

EVE extends Contiki with a Free-RTOS-like layer for the use-cases where traditional multitasking is more preferable. Existing Free-RTOS apps can be easily ported to EVE.

### 6.1.3 Bootloader

The EVE micro-kernel includes a bootloader which provides API for in-circuit re-flashing of the MCU. The bootloader supports firmware upgrade over BLE and over HTTP.

### 6.1.4 Debug interface

The two-pin SWD interface is used for debugging, and SWO interface is used for debug prints and traces. This standard interface means that almost any SWD/SDO-compatible ICE debugger can be used with the EVE.

The EVE Reference board has a built-in SWD/SDO GDB-compatible ICE debugger with USB interface for debugging. The debugger is supported by the EVE software development environment.

## 6.2 BLE

### 6.2.1 Protocols

Bluetooth® 4.1 compliant low energy single-mode protocol stack, S132 supported by Nordic nRF52832 device:

- Link layer, L2CAP, ATT, SM, GATT (Client and Server) and GAP

Central side functionality:

- Central and Observer roles - up to 8 simultaneous connections
- Security Manager including MITM and OOB pairing

Peripheral side functionality:

- Concurrent Peripheral and Broadcaster roles
- Full SMP support including MITM and OOB pairing

## 6.3 Ethernet

Contiki provides support for IPv4 through uIP TCP/IP stack. EVE Platform implements buffer management and retransmission primitives for the uIP, significantly increasing robustness of the stack. It also provides a Berkeley socket interface on top of the Ethernet uIP and the Free-RTOS emulation layer.

### 6.3.1 JSON engine

The EVE Platform proposes a lightweight integrated HTTP and JSON engine as a backend for the products homepage functionality. The engine serves directly two types of resources: static (typically files on the filesystem, firmware binary) and dynamic (in JSON format). The homepage itself (HTML/CSS/JS/graphics) is always static, dynamics is done by applying JSON data on top.

The advantage of the HTTP/JSON engine over classical server-based rendering is that it reduces resource requirements at the server side and thus reduces system cost. Static resources are put in serial FLASH memory. No MCU intervention is needed for processing the resources. All JSON data is handled by the same fixed-size code. Total cost of adding a new JSON variable to the system is as small as 16 byte in the MCU FLASH (plus the variable itself). Explicit distinguishing between data and representation allows to design quite complex homepage applications with very limited resources. This approach allows also updating (up to complete redesign) of the homepage without a modification of the MCU program (with no writes to the MCU internal FLASH).

The engine uses concept of JSON variable, a named entity, C variable, field in a structure, or just an abstraction like "command", exposed to the HTTP-based API. Variables can be grouped into structures, and the structures can be nested. The engine supports also arrays of variables. All variables are described in a table of content ("TOC table"), where variable properties like type, ranges and addresses are defined for each of them. Powered by C++ compile-time expressions, the TOC table definition generates a set of internal tables, used by the engine to access variables.

### 6.3.2 Web browser access

The EVE Platform provides multicast DNS and LLMNR servers for addressing connected devices. The server resolves human-readable device addresses in .local zone (like "http://myproduct.local/") to the product IP addresses.

# 7 REVISION HISTORY

| Revision: | Date: | Description |
|---|---|---|
| 1.00 | 15. Aug. 2017 | First release |
| 1.10 | 15. Aug. 2017 | Second release |
| 1.21 | 27. Sep. 2017 | Upgraded voltage ref. for ADC calibration and improved monitoring of valid +5V availability. |

# 8 ORDERING INFORMATION

## 8.1 Part number structure

<EVE family>-<Interface><-Comm. carrier>-<Flash size><Prod.version><Voltage>-<Revision>

| Code | Possible values | Description |
|---|---|---|
| EVE family: | EVE2 | |
| Interface: | BLE | |
| Comm. carrier: | blank | No extra communication carrier |
| | ETH | Ethernet communication carrier |
| | RS485 | RS485 communication carrier |
| | CAN | CAN communication carrier |
| Flash size: | 512 | 512 kbytes |
| Prod.version: | S | Production version (S=Standard) |
| Voltage: | 3.3 | 3.3V |
| Revision: | Rx.yy | x = Main revision number, yy = Minor revision number |

## 8.2 Available parts

| Part number | Module Size | Pins | FLASH Size | Voltage | Status |
|---|---|---|---|---|---|
| EVE2-BLE-ETH-512S3.3-R1.00 | 18x40x3.0 mm | 52 | 512 kbytes | 3.3V | Obsolete |
| EVE2-BLE-ETH-512S3.3-R1.10 | 18x40x3.0 mm | 52 | 512 kbytes | 3.3V | Obsolete |
| EVE2-BLE-ETH-512S3.3-R1.21 | 18x40x3.0 mm | 52 | 512 kbytes | 3.3V | Active |