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# Bluetooth Low Energy (BLE) 5 Micro Module BC832

Ver 2.01 Dec. 2017

BluNor BC832 is a powerful, highly flexible, ultra low power Bluetooth Low Energy (BLE) using Nordic nRF52832 SoC. With an ARM Cortex™ M4F MCU, 512KB flash, 64KB RAM, embedded 2.4GHz multi-protocol transceiver, and an integrated chip antenna. It allows faster time to market with reduced development cost.

For applications needing limited number of IO pins, prototyping and production are easier using 16 castellated pins. Additional 20 LGA (Land Grid Array) pins provide access to 30 GPIOs of nRF52832 CIAA.

## Specifications:

- Nordic nRF52832 with ARM Cortex M4F.
- Complete RF solution with integrated antenna
- Integrated DC-DC converter, needs external inductors
- Serial Wire Debug (SWD)
- Nordic SoftDevice Ready
- Over-the-Air (OTA) firmware update
- Flash/RAM: 512KB/64KB.
- 30 General purpose I/O pins
- 12 bit/200KSPS ADC
- 3 SPI Master/Slave (8Mbps)
- Low power comparator
- Two 2-wire Master/Slave (I<sup>2</sup>C compatible)
- I2S audio interface
- UART (with CTS/RTS and DMA)
- 20 channel CPU independent Programmable Peripheral Interconnect (PPI).
- Quadrature Demodulator (QDEC)
- 128-bit AES HW encryption
- 5 x 32 bits, 3 x 24 bits Real Time Counters (RTC)
- NFC-A tag interface for OOB pairing
- Receiver Sensitivity: -96 dBm
- TX power: +/- 0 dBm; programmable +4dBm to -20dBm in 4 dB steps.
- Sizes: 7.8x8.8x1.3mm
- Hybrid pins: 16 castellated and 20 LGA.
- Integrated chip antenna
- FCC ID: X8WBC832
- Industrial Canada: 4100A-BC832
- CE: Approved
- QDID: 97989
- Operation voltage: 1.7V to 3.6V
- Operation temperature: -40°C to +85°C



## Applications

- IoT (Internet of Things)
- Wearable
- Beacons/Proximity
- Fitness/Sports
- Smart toys
- Connected appliances
- Lighting products
- Sensors
- Home and building automation
- Key fobs
- Wrist watches
- Wireless charger
- Interactive entertainment devices

## Model Summaries

module	BC832
SoC	nRF52832-CIAA
Flash/RAM	512KB/64KB
Bluetooth range	50 meters

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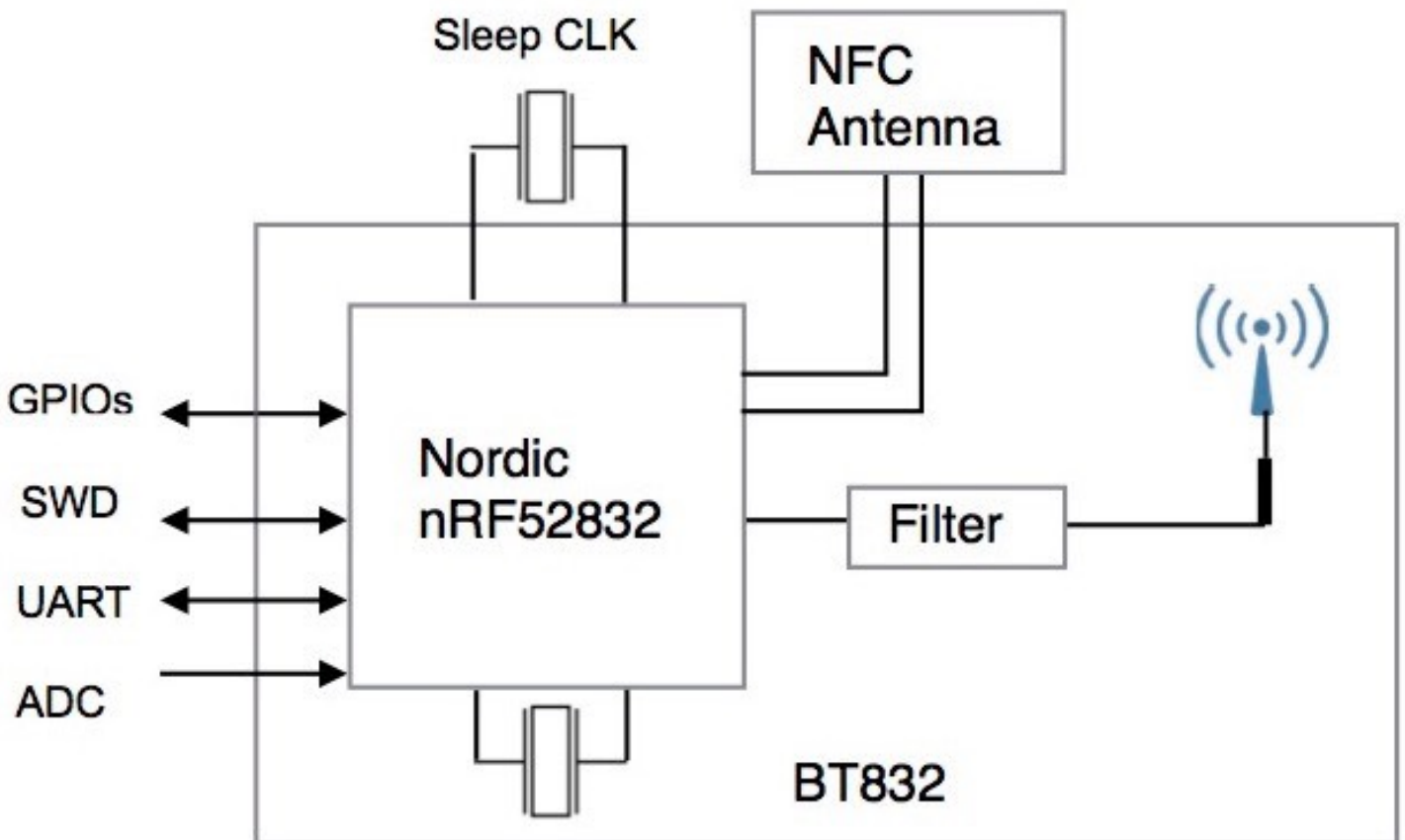
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## 1. Introduction

BluNor BC832 is powerful, highly flexible, ultra low power Bluetooth Low Energy (BLE) modules using Nordic nRF52832 SoCs. With an ARM Cortex™ M4F MCU, 512KB flash, 64KB RAM, embedded 2.4GHz multi-protocol transceiver, and an integrated antenna, it allows faster time to market with reduced development cost.

The following is a block diagram of BC832. Antenna circuit and main clock are integrated. All 32 GPIOs of nRF52832 can be accessed from main board. For lower power consumption at idle state, a 32.768 kHz crystal is added on the main board. Connection to an external NFC (Near Field Communication) antenna is provided.

## 2. Codes Development Using Nordic Tools



Development tools by Nordic and other third party development tools recommended by Nordic should be used .

### Easy, fast and safe code development

Nordic development environment for nRF52832 offers a clean separation between application code development and embedded protocol stacks. This means compile, link and run time dependencies with the embedded stack and associated debugging challenges are removed. The Bluetooth low energy and ANT stack is a pre-compiled binary, leaving application code to be compiled stand-alone. The embedded stack interface uses an asynchronous and event driven model removing the need for RTOS frameworks.

### Over-The-Air DFU

The nRF52832 is supported by an Over-The-Air Device Firmware Upgrade (OTA DFU) feature. This allows for in the field updates of application software and SoftDevice.

## SoftDevices

The Nordic protocol stacks are known as SoftDevices and complement the nRF52 Series SoCs. All nRF52 Series are programmable with software stacks from Nordic. This brings maximum flexibility to application development and allows the latest stack version to be programmed into the SoC.

SoftDevices available from Nordic:

**S132:** Bluetooth low energy concurrent central/peripheral/observer/broadcaster stack.

SoftDevices available from ANT Wireless:

**S212:** ANT stack

**S332:** Bluetooth low energy concurrent central/peripheral/observer/broadcaster/ANT stack.

## Development Tools

Nordic Semiconductor provides a complete range of hardware and software development tools for the nRF52 Series devices. nRF52 DK board is recommended for firmware development.

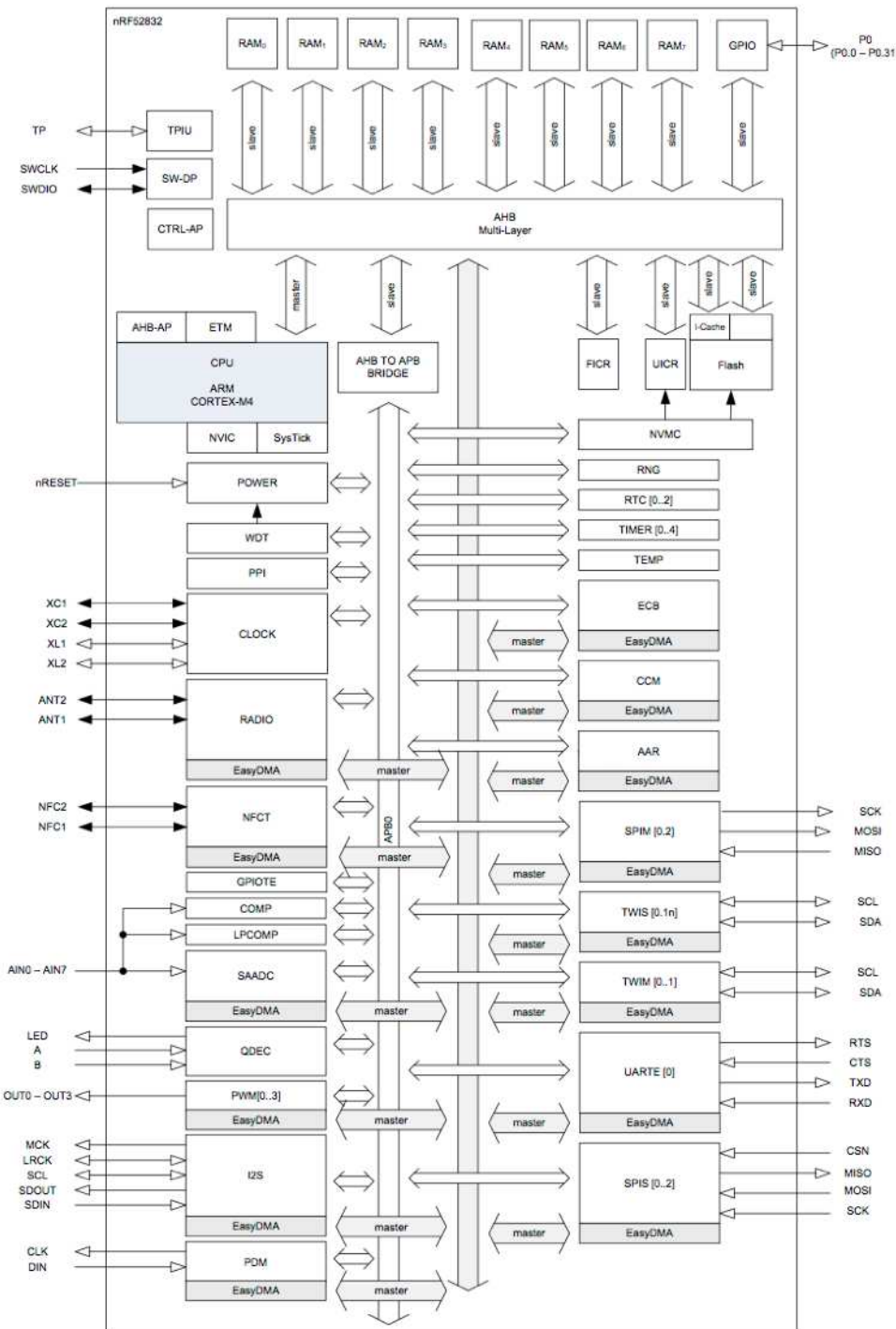
## 3. Product Overview

Brief description of nRF52832 SoC is provided. For full description of the SoC, please download from Nordic Semiconductor website.

<https://www.nordicsemi.com/eng/Products/Bluetooth-low-energy>

## Block Diagram

The following is a block diagram of Nordic nRF52832 Bluetooth Low Energy (BLE) SoC.



The 32 bit ARM Cortex M4F MCU with hardware supports for DSP instructions and floating point operations, code density and execution speed are higher than other Cortex M MCU. The Programmable Peripheral Interconnect (PPI) system provides a 20-channel bus for direct and autonomous system peripheral communication without CPU intervention. This brings predictable latency times for peripheral to peripheral interaction and power saving benefits associated with leaving CPU idle. The device has 2 global power modes ON/OFF, but all system blocks and peripherals have individual power management control which allows for an automatic switching RUN/IDLE for system blocks based only on those required/not required to achieve particular tasks.

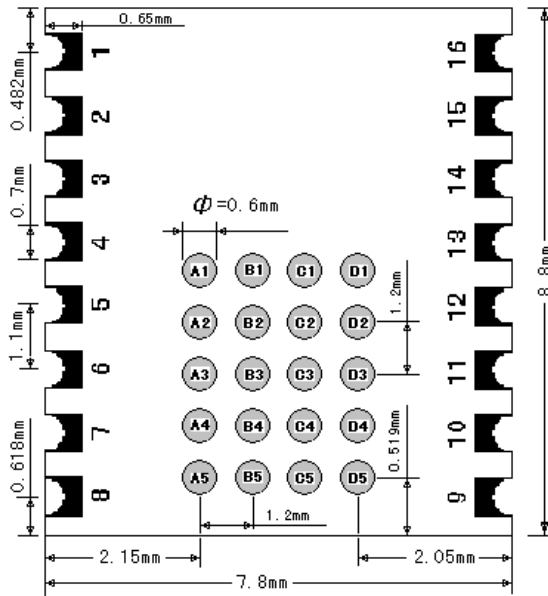
The radio supports Bluetooth low energy and ANT. Output power is scalable from a maximum of +4dBm down to -20 dBm in 4dB steps. Sensitivity is increased to -96 dBm to -89 dBm, depending on data rate. Sensitivity for BLE is -96 dBm, and -92.5 dBm for ANT.

The NFC block supports NFC-A tags with proximity detection and Wake-on-field from low power mode. The NFC enables Out-Of-Band (OOB) Bluetooth pairing of devices and thus greatly simplifying deployment.

## Mechanical Drawing

The following is a mechanical drawing of BC832. Two types of pins are available to meet different application requirements.

- 16 castellated pins for application needing limited number of IOs. SMT equipment is not required for soldering castellated pins.
- 20 LGA (Land Grid Array) pins to access all 32 GPIOs of nRF52832 when needed.



## BC832 Photo

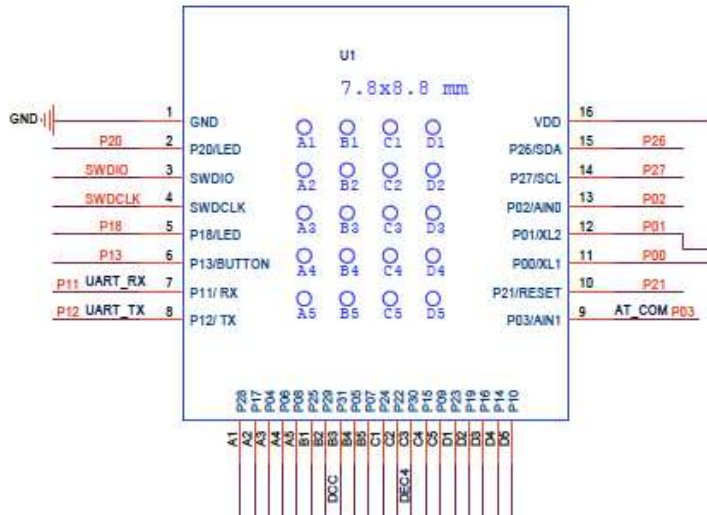




## Pin Assignments of BC832

The followings are BC832 pin assignment. Pin functions are in a table in next section. Please refer to Nordic nRF52832 Product Specifications for detailed descriptions and features supported.

[http://infocenter.nordicsemi.com/pdf/nRF52832\\_PS\\_v1.1.pdf](http://infocenter.nordicsemi.com/pdf/nRF52832_PS_v1.1.pdf)



There are two versions of BC832.

- BC832 V0. This version has all 32 GPIO pins of nRF52832 CIAA available. There is no connection for 2 inductors required for built-in DC to DC converter. DC to DC converter shall not be enabled by firmware.
- BC832 V1. To provide external connection for 2 inductors required for DC to DC converter, pins B3 and C3 are used for inductor connection. Pins B5 (P031) and A5(P030) of nRF52832 CIAA are not available at BC832 V1 pins. BC832 V1 should be used in new designs.

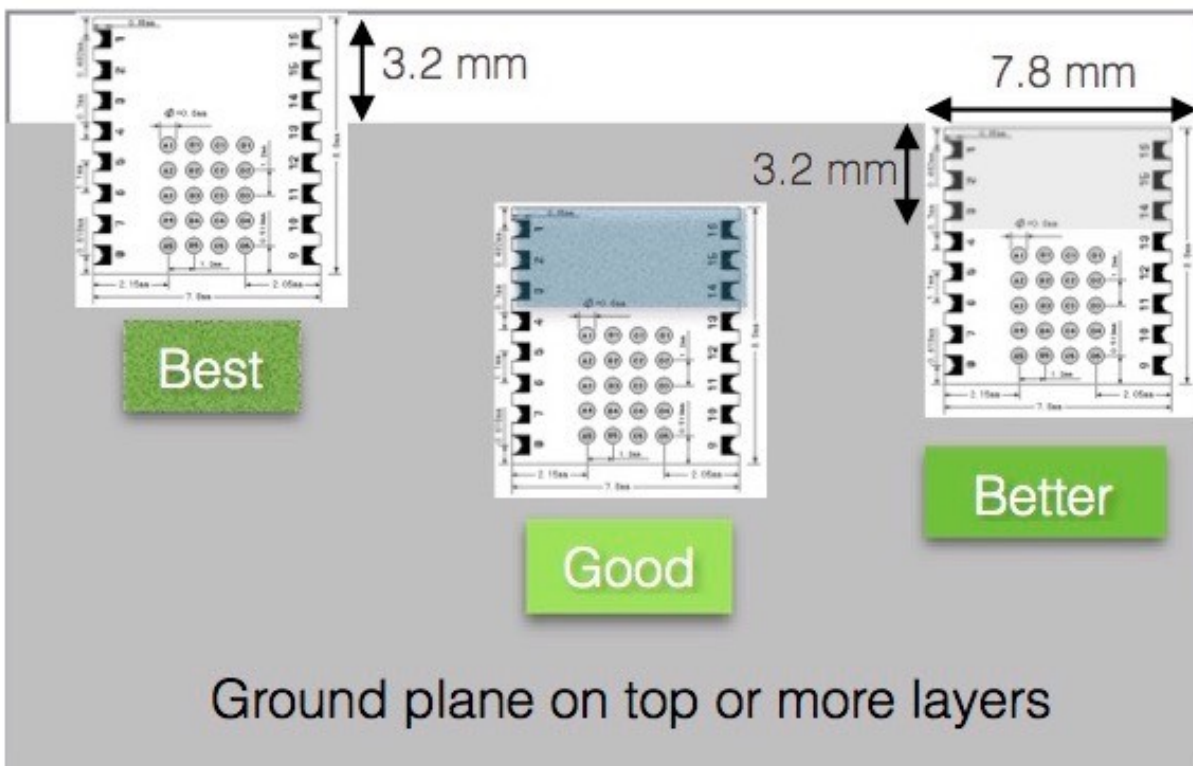
## Pin Functions

BC832		nRF52832 CIAA		
pin#	pin name	pin#	pin name	Descriptions
1	GND	C5	VSS	Ground
2	P20	G2	P0.20	GPIO, LED pin on EV-BC832
3	SWDIO	G1	SWDIO	GPIO, connection for 32.768kHz crystal
4	SWDCLK	F1	SWDCLK	Serial Wire Debug I/O
5	P18	H2	P0.18	GPIO, LED pin on EV-BC832
6	P13	G4	P0.13	GPIO, button pin on EV-BC832
7	P11	H6	P0.11	UART RX
8	P12	F4	P0.12	UART TX
9	P03/AIN1	D6	P0.03	GPIO, Analog input 1
10	P21/RESET	H1	P0.21	configured as reset on EV-BC832
11	P00/XL1	D7	P0.00	GPIO, connection for 32.768kHz crystal
12	P01/XL2	C7	P0.01	GPIO, connection for 32.768kHz crystal
13	P02/AIN0	C6	P0.02	GPIO, Analog input 0
14	P27/SCL	B4	P0.27	GPIO, configured as I2C SCL on EV-BC832
15	P26/SDA	D3	P0.26	GPIO, configured as I2C SDA on EV-BC832
16	VDD	A7	VDD	DC power supply, 1.7V to 3.6V
A1	P28	A3	P0.28	GPIO
A2	P17	G3	P0.17	GPIO
A3	P04	E6	P0.04	GPIO
A4	P06	F7	P0.06	GPIO
A5	P08	G7	P0.08	GPIO
B1	P25	B3	P0.25	GPIO
B2	P29	A4	P0.29	GPIO
B3	P31/DCC	B5	P0.31	P31 in BC832 V0; DCC for inductor connection in BC832 V1
B4	P05	E7	P0.05	GPIO
B5	P07	F6	P0.07	GPIO
C1	P24	E1	P0.24	GPIO
C2	P22	F2	P0.22	GPIO
C3	P30/DEC4	A5	P0.30	P30 in BC832 V0; DEC4 for inductor connection in BC832 V1
C4	P15	H4	P0.15	GPIO
C5	P09	G6	P0.10/NFC1	GPIO, NFC antenna connection
D1	P23	E2	P0.23	GPIO
D2	P19	F3	P0.19	GPIO
D3	P16	H3	P0.16	GPIO
D4	P14	H5	P0.14	GPIO
D5	P10	G5	P0.10/NFC2	GPIO, NFC antenna connection

## Mounting BC832 on the Host PCB

The following figure shows recommended mounting of BC832 module on the host PCB.

- For the best Bluetooth range performance, the antenna area of module shall extend 3.2 mm outside the edge of a ground plane.
- The next choice is to place module on a corner of host PCB. No ground plane directly below the 3.2x7.8mm antenna area of module.
- For wearable, it is acceptable to place a coin battery directly below the antenna area of module. Bluetooth range is reduced but acceptable when pairing with a smartphone on the antenna side. Bluetooth signal is blocked on the battery side.



1. BC832 module extends 3.2 mm from ground plane of the host PCB board.
2. No ground plane on all layers in the 3.2x7.8mm antenna area.
3. A coin battery can be mounted directly below antenna area with reduced range performance

## 4. AT Commands

BC832 module is available with firmware supporting AT commands. Part number is BC832-AT.

## Brief description of AT commands

- Each command line consists of a prefix, a body and a terminator.
- All command lines begin with the prefix AT (ASCII 065, 084) or at (ASCII 097, 116).
- The body is a string of characters in the ASCII range 032-255. Control characters other than <CR> (carriage return; ASCII 013) and <BS> (back space; ASCII 008) in a command line are ignored.
- The terminator is <CR>.
- There is no distinction between upper-case and lower-case characters. A command line can have a maximum length of 80 characters. It is automatically discarded if the input is longer. Corrections are made
- AT command is case-insensitive, following /r/n for end code.
- The default baud rate is 9600 one stop bit and no parity

## Command mode

When P0.03 of nRF52832 (pin 9 of BC832) is pulled high, it is set to AT command mode. In AT command mode, the host processor communicates with the processor on BC832.

<i>Command</i>	<i>Response</i>	<i>Parameter</i>	<i>example</i>
AT	OK or FAIL	none	AT/r/n OK/r/n
AT+RESET	OK or FAIL	none	AT+RESET/r/n OK/r/n
AT+VERSION?	+VERSION:<param> OK	Software version number	AT+VERSION?/r/n +VERSION140804 OK/ r/n
AT+NAME?	+NAME:<param> OK	Device name	AT+NAME?/r/n +NAME:EZPro OK/r/n
AT+NAME=<param>	OK or FAIL	Device name	AT+NAME=Fanstel/r/n Or AT_Name="Fanstel"/r/n OK/r/n
AT+UART?	+UART:<param>,<param2>,<param3> > OK	Baud rate, Stop bit, Parity	AT+UART?/r/n +UART:115200,1,0 OK/r/n
			AT+UART=115200/r/n +UART:115200,1,0

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AT+UART=<parm>	+UART:<parm>	Baud rate	OK/r/n 1200 2400 4800 9600 default 19200 38400 57600 115200 230400 460800 921600 1000000
AT+ADDR?	+ADDR:<param> OK	Device MAC address	AT+ADDR?/r/n +ADDR:abb5:cd:604ace OK/r/n
AT+REGISTER	OK or FAIL	none	AT+REGISTER/r/n OK/r/n
AT+QUITREGISTER	OK or FAIL	none	AT+QUITREGISTER/r/n OK/r/n
AT+RX?	+Name:<parm> +UART:<parm> +ADDR:<parm>	none	AT+RX?/r/n +NAME:EZPro/r/n +UART:115200,1,1/r/n +ADDR: abb5:cd:604ace/r/n
AT+DEFAULT	OK or FAIL	none	AT+DEFAULT/r/n OK/r/n
AT_RFPW?	+RFPW:parm	+4~-8	AT+RFPW?/r/n +RFPW:-4 OK/r/n 0:+4 1:+0 default 2:-4 3:-8
			AT+RFPW= 1/r/n

AT_RFPW=<parm>	OK or FAIL	+4~-8	OK/r/n 0:+4 1:+0 2:-4 3:-8
AT+PIO=<param><param1>	OK or FAIL	P00-P05 1=High , 0=low	AT+PIO=05, 0\r\n OK/r/n
AT+PIS=<param><param1>	OK or FAIL	P00-P05 1=output, 0=input	AT+PIS=05, 1\r\n OK/r/n

## Data Mode

When P0.03 of nRF52832 (pin 9 of BC832) is pulled low, it is set to data mode. In data mode, BC832 provides transparent data transfer between the host processor and a remote device, for example, a smartphone.

## Communicating with a PC

A quick and easy way to evaluate BC832 is to use a PC as the host processor. Connect the development board EV-BC832 to a PC with an USB cable. Then,

- Set S1, BC832 is set to command mode. PC will communicate with BC832.
- Set switch S1 to the other position, BC832 is set to data mode. PC will communicate with a remote device through BC832 Bluetooth wireless connection.

Docklight is a testing, analysis and simulation tool for serial communication protocols (RS232, RS485/422 and others). It allows you to monitor the communication between two serial devices or to test the serial communication of a single device. Docklight significantly increases productivity in a broad range of industries, including automation and control, communications, automotive, equipment manufacturers, and embedded / consumer products. Docklight is easy to use and runs on almost any standard PC using Windows 10, Windows 8, Windows 7, Windows Vista or Windows XP operating system.

Docklight software can be downloaded from the following:

[http://www.docklight.de/download\\_en.htm](http://www.docklight.de/download_en.htm).

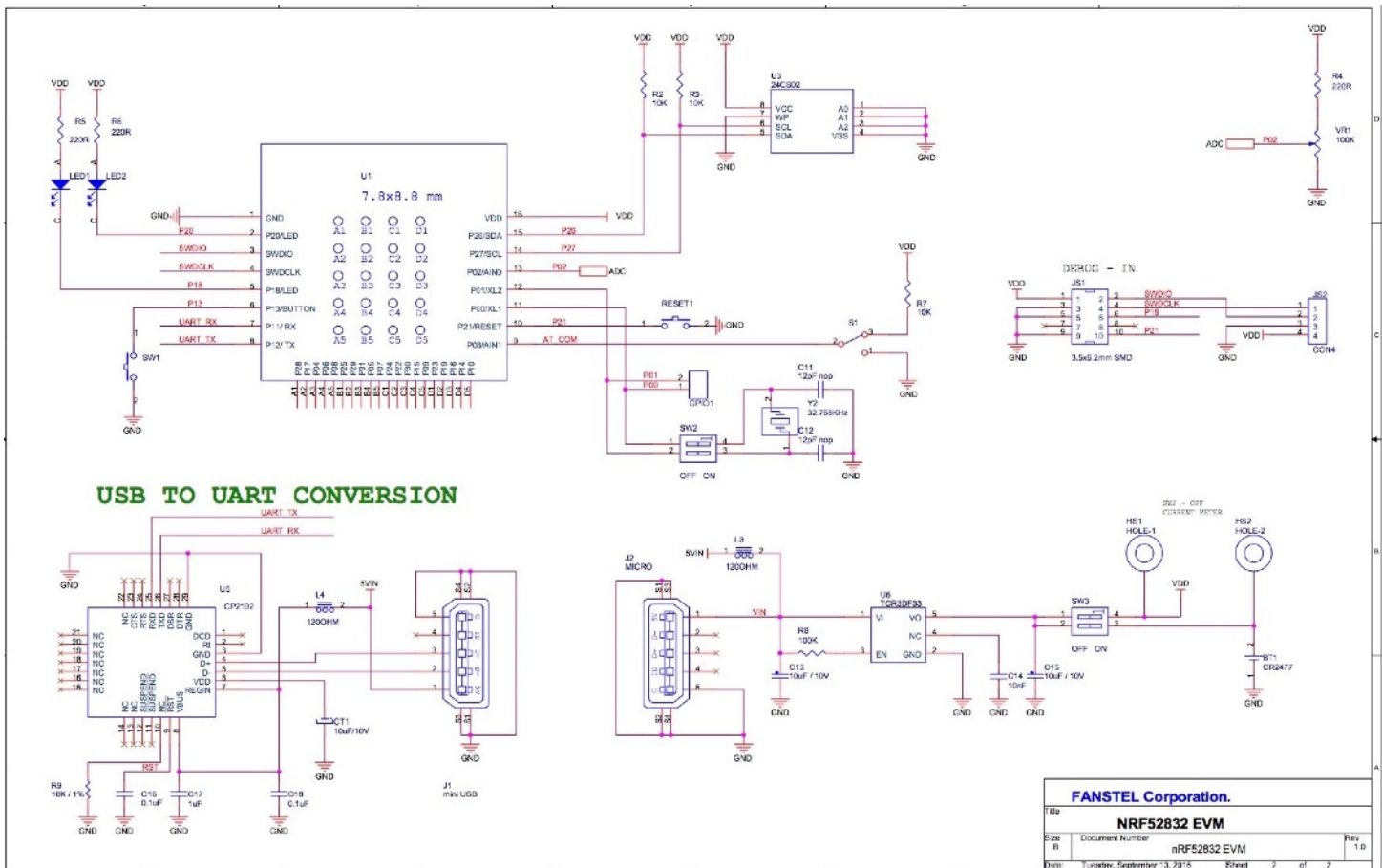
## 5. Evaluation Board

### EV BC832 Evaluation board schematics

Evaluation board schematics and Gerber files can be downloaded from

<http://www.fanstel.com/download-document/>

Library component for your PCB layout can be extracted from Gerber files. EV BC832 was developed for evaluation of Bluetooth mesh stacks. All new BC832 evaluation boards are EV BC832 V2.

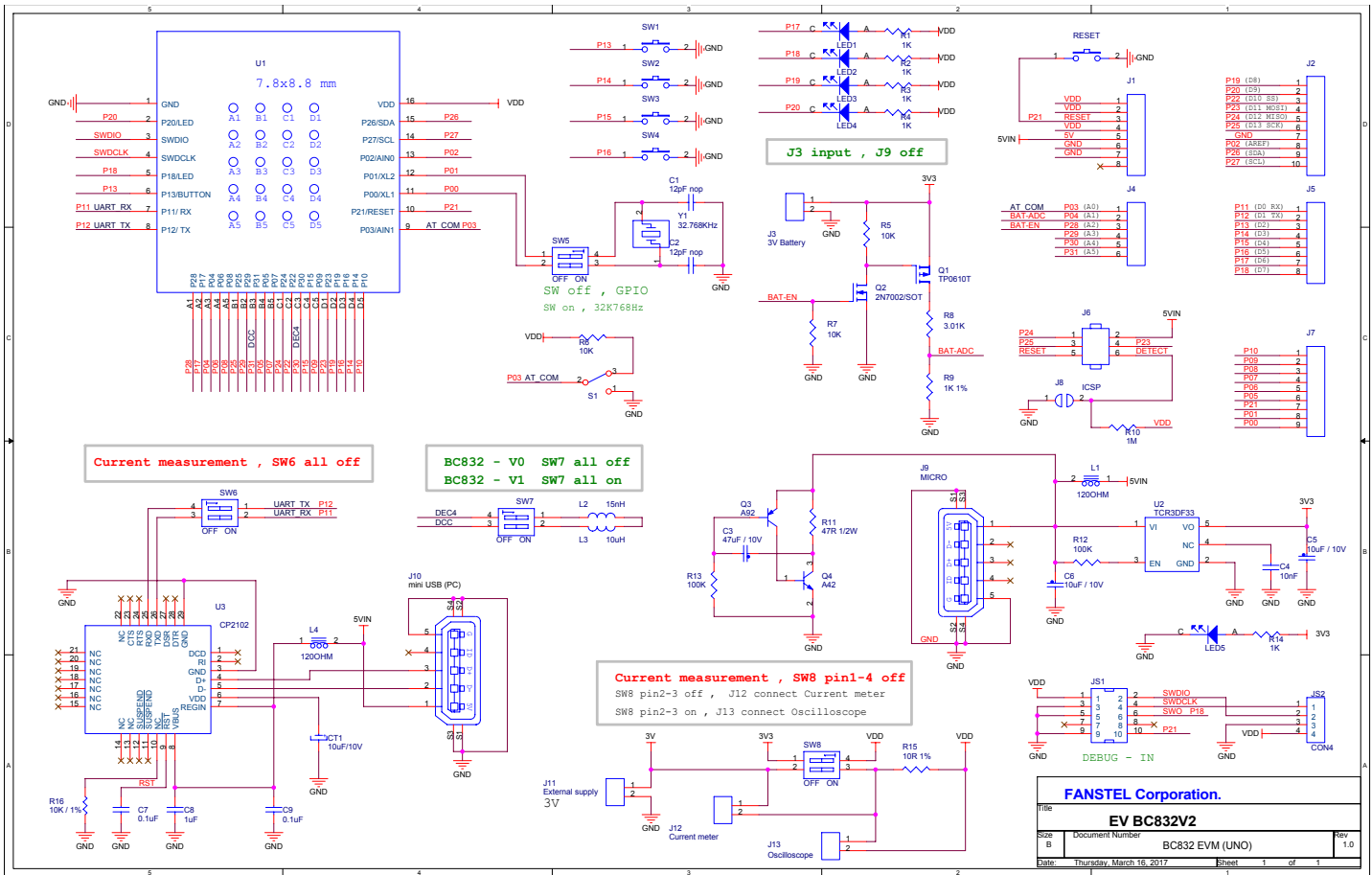


### EV BC832 V2 Evaluation Board Schematics

EV BC832 V2 evaluation board is developed to accommodate BC832 V0 and BC832 V1.

EV BC832 V2 has the same footprint as that of Arduino UNO R3. It is not an UNO R3 compatible board. Many UNO R3 shields can be used with EV BC832.

- It is preloaded with firmware for evaluating Bluetooth mesh stacks.
- Firmware can be developed for other applications. You need Nordic nRF52 development tools. An nRF52 DK is recommended for programming.
- If not used on board, all GPIO pins are available at connectors. Whenever possible, with firmware configuration, pin function can be compatible with that of Arduino UNO R3.
- Portable smartphone charger can be used to power this board. The circuitry to the left of micro USB connector, J16 produces periodic load to prevent portable smartphone charger from shutting down.



## Suggestion for Battery Power Application

Standby current consumption is important for battery-powered product. We suggest adding a 32.768 kHz crystal and 2 capacitors on the main board. The 32MHz main clock won't be active at idle state to save power.

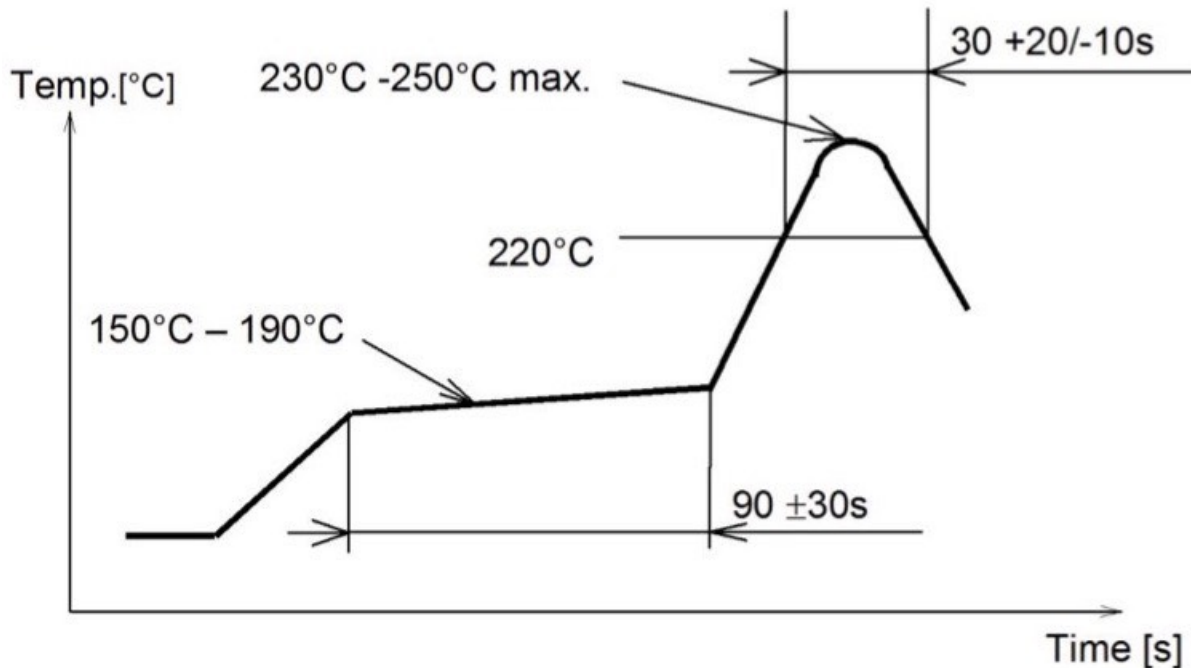
BC832 V1 or newer should be used. Inductors required for DC to DC converter should be added on the main board.



## 6. Miscellaneous

### Soldering Temperature-Time Profile for Re-Flow Soldering

Maximum number of cycles for re-flow is 2. No opposite side re-flow is allowed due to module weight.



### Cautions, Design Notes, and Installation Notes

Failure to follow the guidelines set forth in this document may result in degrading of the product's functions and damage to the product.

#### Design Notes

- (1) Follow the conditions written in this specification, especially the control signals of this module.
- (2) The supply voltage has to be free of AC ripple voltage (for example from a battery or a low noise regulator output). For noisy supply voltages, provide a decoupling circuit (for example a ferrite in series connection and a bypass capacitor to ground of at least 47uF directly at the module).
- (3) This product should not be mechanically stressed when installed.
- (4) Keep this product away from heat. Heat is the major cause of decreasing the life of these products.
- (5) Avoid assembly and use of the target equipment in conditions where the products' temperature may exceed the maximum tolerance.
- (6) The supply voltage should not be exceedingly high or reversed. It should not carry noise and/or spikes.

## Bluetooth Low Energy (BLE) 5 Micro Module BC832

(7) this product away from other high frequency circuits.

### *Notes on Antenna and PCB Layout*

(1) Don't use a module with internal antenna inside a metal case.

(2) For PCB layout:

- Avoid running any signal line below module whenever possible,
- No ground plane below antenna,
- If possible, cut-off the portion of main board PCB below antenna.

### *Installation Notes*

(1) Reflow soldering is possible twice based on the time-temperature profile in this data sheets. Set up the temperature at the soldering portion of this product according to this reflow profile.

(2) Carefully position the products so that their heat will not burn into printed circuit boards or affect the other components that are susceptible to heat.

(3) Carefully locate these products so that their temperatures will not increase due to the effects of heat generated by neighboring components.

(4) If a vinyl-covered wire comes into contact with the products, then the cover will melt and generate toxic gas, damaging the insulation. Never allow contact between the cover and these products to occur.

(5) This product should not be mechanically stressed or vibrated when reflowed.

(6) If you want to repair your board by hand soldering, please keep the conditions of this chapter.

(7) Do not wash this product.

(8) Refer to the recommended pattern when designing a board.

(9) Pressing on parts of the metal cover or fastening objects to the metal will cause damage to the unit.

(10) For more details on LGA (Land Grid Array) soldering processes refer to the application note.

### *Usage Condition Notes*

(1) Take measures to protect the unit against static electricity. If pulses or other transient loads (a large load applied in a short time) are applied to the products, check and evaluate their operation before assembly on the final products.

(2) Do not use dropped products.

(3) Do not touch, damage or soil the pins.

(4) Follow the recommended condition ratings about the power supply applied to this product.

(5) Electrode peeling strength: Do not add pressure of more than 4.9N when soldered on PCB

(6) Pressing on parts of the metal cover or fastening objects to the metal cover will cause damage.

(7) These products are intended for general purpose and standard use in general electronic equipment, such as home appliances, office equipment, information and communication equipment.

#### **Storage Notes**

(1) The module should not be stressed mechanically during storage.

(2) Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance will be adversely affected:

- Storage in salty air or in an environment with a high concentration of corrosive gas.
- Storage in direct sunlight
- Storage in an environment where the temperature may be outside the range specified.
- Storage of the products for more than one year after the date of delivery storage period.

(3) Keep this product away from water, poisonous gas and corrosive gas.

(4) This product should not be stressed or shocked when transported.

(5) Follow the specification when stacking packed crates (max. 10).

#### **Safety Conditions**

These specifications are intended to preserve the quality assurance of products and individual components. Before use, check and evaluate the operation when mounted on your products. Abide by these specifications, without deviation when using the products. These products may short-circuit. If electrical shocks, smoke, fire, and/or accidents involving human life are anticipated when a short circuit occurs, then provide the following failsafe functions, as a minimum.

(1) Ensure the safety of the whole system by installing a protection circuit and a protection device.

(2) Ensure the safety of the whole system by installing a redundant circuit or another system to prevent a dual fault causing an unsafe status.

#### **Other Cautions**

(1) This specification sheet is copyrighted. Reproduction of this data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices.

(2) Do not use the products for other purposes than those listed.

(3) Be sure to provide an appropriate failsafe function on your product to prevent an additional damage that may be caused by the abnormal function or the failure of the product.

(4) This product has been manufactured without any ozone chemical controlled under the Montreal Protocol.

(5) These products are not intended for other uses, other than under the special conditions shown below. Before using these products under such special conditions, check their performance and reliability under the said special conditions carefully to determine whether or not they can be used in such a manner.

- In liquid, such as water, salt water, oil, alkali, or organic solvent, or in places where liquid may splash.
  - In direct sunlight, outdoors, or in a dusty environment
  - In an environment where condensation occurs.
  - In an environment with a high concentration of harmful gas.
- (6) If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these products with new products because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.
- (7) When you have any question or uncertainty, contact Fanstel.

### **Packaging**

Production modules are delivered in reel, 1000 modules in each reel.

### **FCC LABEL**

The Original Equipment Manufacturer (OEM) must ensure that the OEM modular transmitter must be labeled with its own FCC ID number. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown below. If the FCC ID is not visible when the equipment is installed inside another device, then the outside of the device into which the equipment is installed must also display a label referring to the enclosed equipment

The end product with this module may subject to perform FCC part 15 unintentional emission test requirement and be properly authorized.

This device is intended for OEM integrator only.

## Revision History

- December 2017. Ver. 2.01: Add QDID number and clarify specifications

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