Bluetooth 5 Module BT832, BT832A, BT832F, BT832AF

BluNor BT832 Series is a powerful, highly flexible, ultra low power Bluetooth Low Energy (BLE) modules using Nordic nRF52 SoC. With an ARM Cortex™ M4(F) MCU, up to 512KB flash, 64KB RAM, embedded 2.4GHz multi-protocol transceiver, and an integrated PCB trace 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 24 LGA (Land Grid Array) pins provide full access to 32 GPIOs of nRF52832.

Bluetooth 5 specifications allow reducing bandwidth to achieve up to 4X range while maintaining similar power requirements. Line of sight range between two BT832Fs is measured at 220 to 330 meters at 1Mbps data rate. Average of 12 measurements (rotate one antenna by 30º each time) is 270 meters. BT832Fs achieve longer range by superior antenna circuit and without an external power amplifier, not by reducing bandwidth.

Specifications:

- Nordic nRF52 with ARM Cortex M4F.
- Complete RF solution with integrated antenna
- Integrated DC-DC converter
- Serial Wire Debug (SWD)
- Nordic SoftDevice Ready
- Over-the-Air (OTA) firmware update
- Flash/RAM: 512KB/64KB or 256KB/32KB.
- 32 General purpose I/O pins
- 12 bit/200KSPS ADC, 8 configurable channels with programmable gain.
- 3X SPI Master/Slave (8Mbps)
- 3X 4-channel pulse width modulator (PWM)
- Low power comparator
- 2X 2-wire Master/Slave (I2C 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)
- Available NFC-A tag interface for OOB pairing
- Receiver Sensitivity: -96 dBm at 1Mbps
- TX power: +/- 0 dBm; programmable 4 dBm to -20dBm in 4 dB steps.
- Hybrid pins: 16 castellated and 24 LGA.
- Integrated PCB trace antenna:
- Operation voltage: 1.7V to 3.6V
- Embedded inductors for DCDC converter
- Operation temperature: -40°C to +85°C
- FCC ID: X8WBT832
- IC ID: 4100A-BT832
- CE: Certified
- QDID: 97989

Applications

- Wearable
- Beacons/Proximity
- Fitness/Sports
- Smart toys
- Connected appliances
- Lighting products

- Sensors
- Home and building automation
- Key fobs
- Wireless charger
- Interactive entertainment devices

Model Summaries

| module	BT832	BT832A	BT832F	BT832AF
SoC	nRF52832 QFAA	nRF52810 QFAA	nRF52832 QFAA	nRF52810 QFAA
Flash/RAM	512KB/64KB	192KB/24KB	512KB/64KB	192KB/24KB
Size	14x16x1.9mm	14x16x1.9mm	15x20.8x1.9mm	15x20.8x1.9mm
Average Bluetooth range	100 meters	100 meters	270 meters	270 meters
NFC	Yes	No	Yes	No

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1. Introduction

BluNor BT832 is powerful, highly flexible, ultra low power Bluetooth Low Energy (BLE) modules using Nordic nRF52 SoCs. With an ARM Cortex™ M4F MCU, available 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 BT832. 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 host board. Connection to an external NFC (Near Field Communication) antenna is provided.

BlurNor BT832A, BT832F, and BT832AF are sister module of BT832. The foot print for for the main body of module is identical. The difference are in PCB trace antenna area and memory sizes.

In this data sheets, BT832 and BT832A can be referred as BT832. BT832AF and BT832F can be referred as BT832F. All modules BT832, BT832A, BT832F, and BT832AF can be referred as BT832.

BT832 Block Diagram
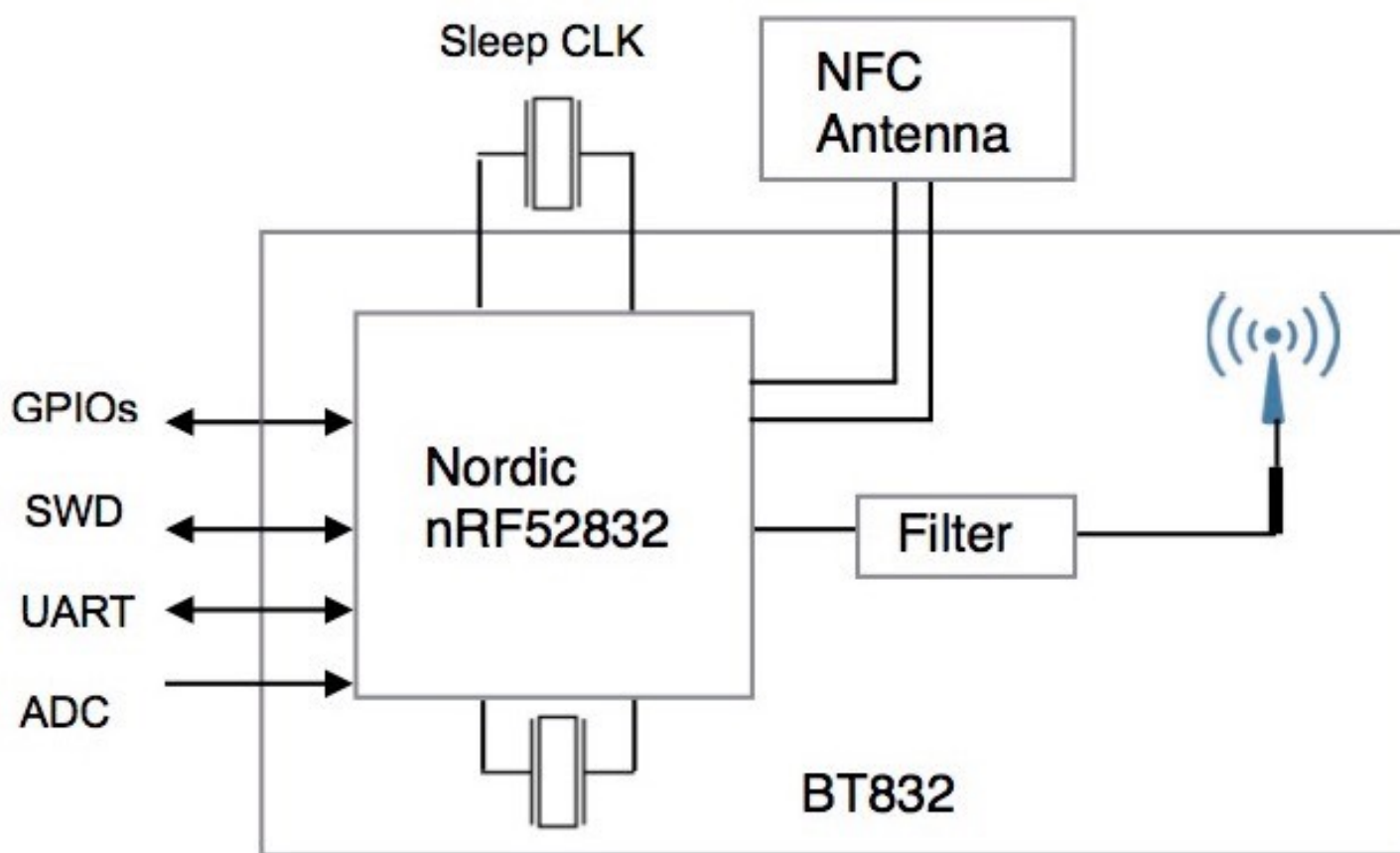
BT832 Series modules have the same features except the followings.

BT832

- Uses an nRF52832 QFAA with Cortex M4F MCU
- 512KB flash, 64 KB RAM
- Supports NFC
- Integrated PCB trace range antenna. Average range is 100 meters. Minimum range and Maximum range around a circle is 75 meters and 140 meters, respectively.
- Size: 14x16x1.9mm.

BT832A

- Uses an nRF52810 QFAA with Cortex M4 MCU

- 192 KB flash, 24 KB RAM

- Does not support NFC

- Integrated PCB trace range antenna. Average range is 100 meters. Minimum range and Maximum range around a circle is 75 meters and 140 meters, respectively.

- Size: 14x16x1.9mm.

BT832F

- Uses an nRF52832 QFAA with Cortex M4F MCU

- 512KB flash, 64 KB RAM

- Supports NFC

- Integrated PCB trace range antenna. Average range is 270 meters. Minimum range and Maximum range around a circle is 220 meters and 330 meters, respectively.

- Size: 15x20.8x1.9mm.

BT832AF

- Uses an nRF52810 QFAA with Cortex M4 MCU

- 192 KB flash, 24 KB RAM

- Does not support NFC

- Integrated PCB trace range antenna. Average range is 270 meters. Minimum range and Maximum range around a circle is 220 meters and 330 meters, respectively.

- Size: 15x20.8x1.9mm

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 nRF52 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 nRF52 SoC 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 bring 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.

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.

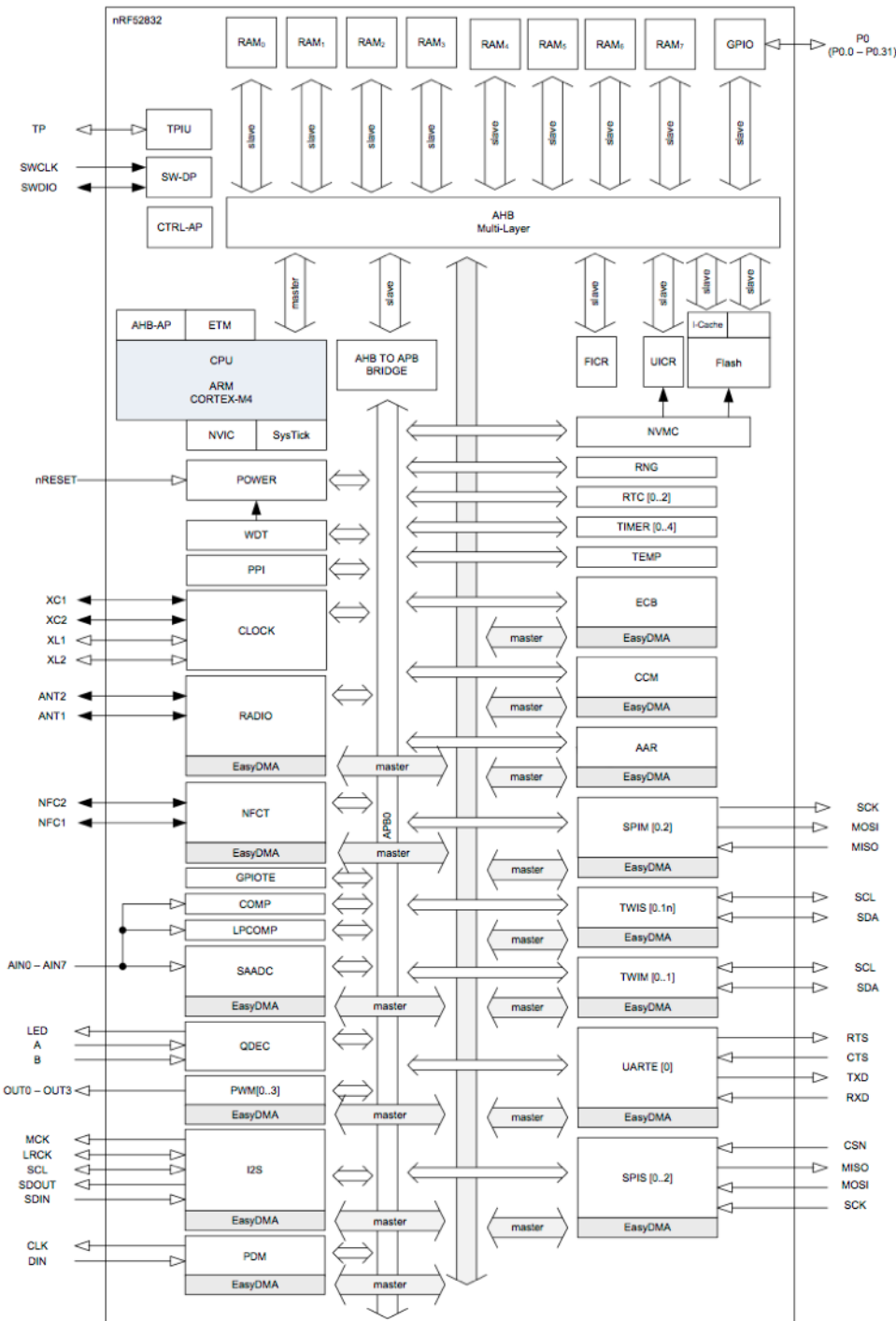## 3. Product Overview

Nordic SoCs

For full description of the SoC, please download data sheets from Nordic Semiconductor website.

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

The following is a block diagram of Nordic nRF52832 Bluetooth Low Energy (BLE) SoC. NFC is not supported in nRF52810.

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.
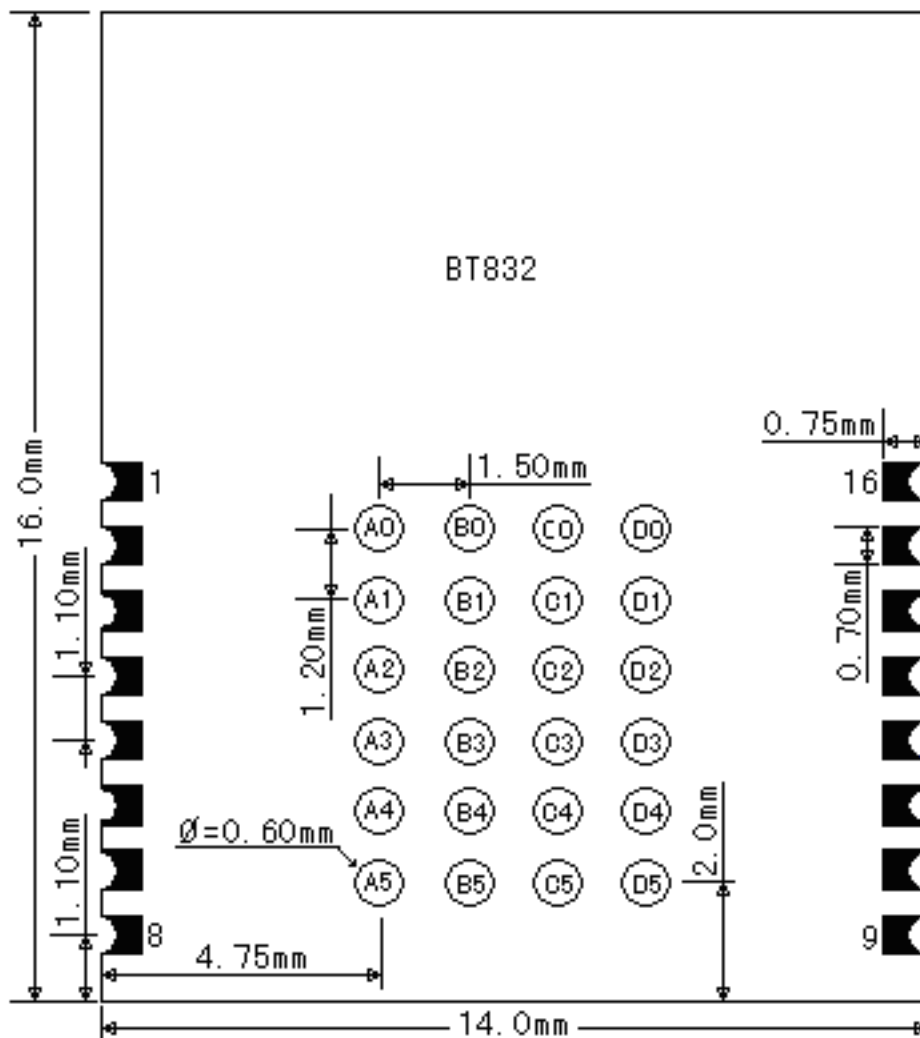
Mechanical Drawings

The followings are mechanical drawings of BT832 and BT832F. The bottom portion of module is the main body (size: 14.0 x 9.57mm) with electronic components and pins for connection to the host board. The top portion of module is for integrated PCB trace antenna. BT832 and BT832F have identical main body. BT832F has a larger antenna area to accommodate a higher performance antenna.

We recommend layout the host PCB with clearance for the larger antenna area of BT832F. If the ultra long Bluetooth line of sight range of BT832F is not required, the lower cost BT832 can be installed.

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.
- 24 LGA (Land Grid Array) pins to access all 32 GPIOs of nRF52832 when needed.

BT832 and BT832A mechanical drawing, top view

BT832F and BT832AF mechanical drawing, top view
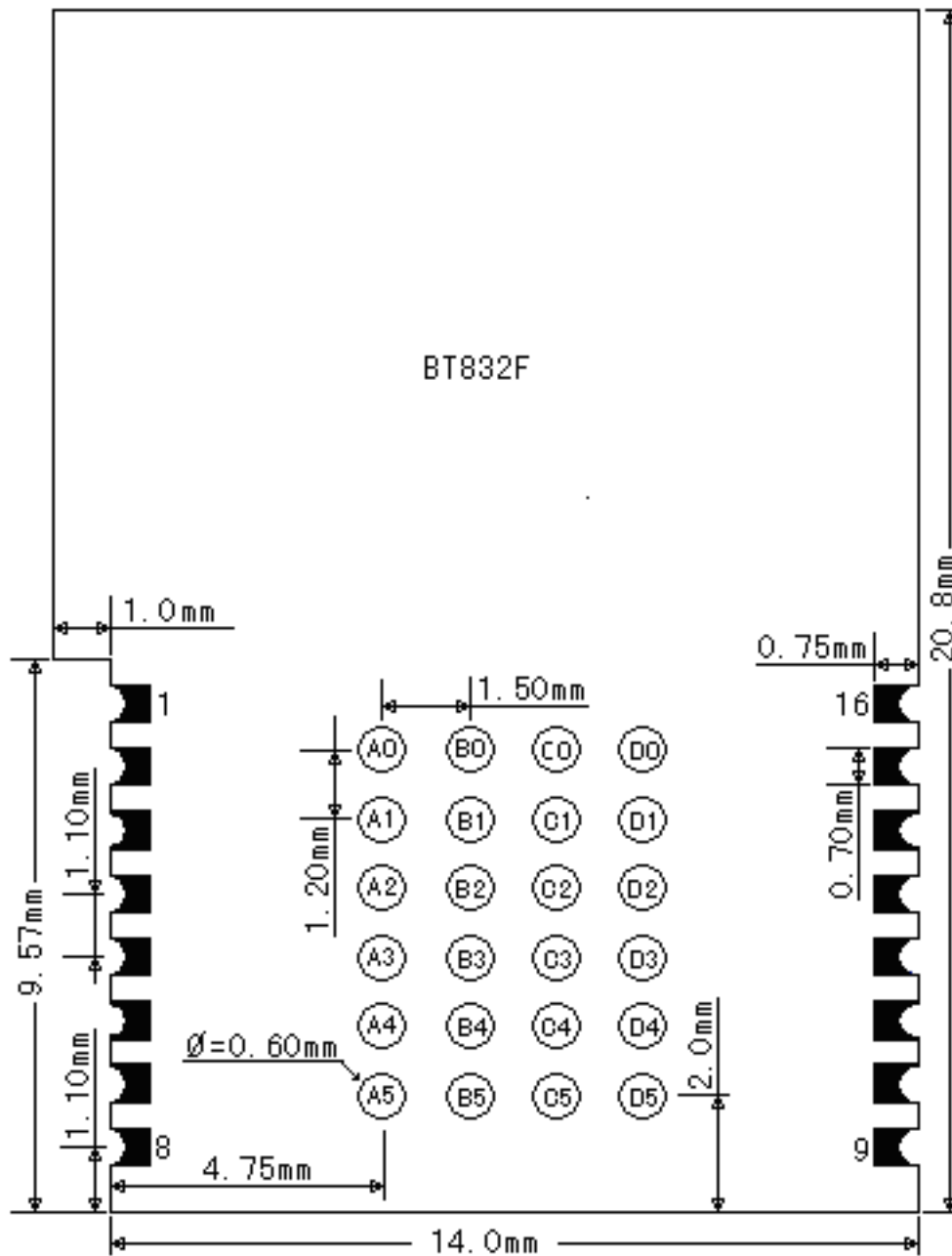
Pin Assignments of BT832

The followings are BT832 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
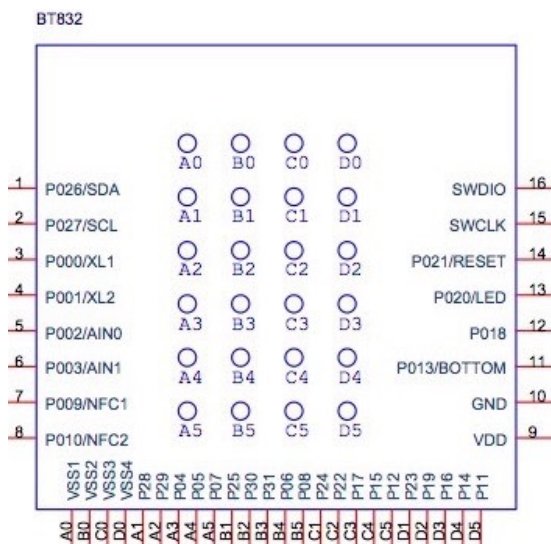
Pin Functions

BT832 pin#	pin name	nRF52832/nRF52810 pin#	pin name	Descriptions
1	P26/SDA	38	P0.26	GPIO, configured as I2C SDA on EV-BT832
2	P27/SCL	39	P0.27	GPIO, configured as I2C SCL on EV-BT832
3	P00/XL1	2	P0.00/XL1	GPIO, connection for 32.768kHz crystal
4	P01/XL2	3	P0.01/XL2	GPIO, connection for 32.768kHz crystal
5	P02/AIN0	4	P0.02/AIN0	GPIO, Analog input
6	P03/AIN1	5	P0.03/AIN1	GPIO, Analog input
7	P09/NFC1	11	P0.09/NFC1	GPIO, NFC antenna connection (nRF52832 only)
8	P10/NFC2	12	P0.10/NFC2	GPIO, NFC antenna connection (nRF52832 only)
9	VDD	13	VDD	DC supply 1.7V to 3.6V
10	GND	45	VSS	Ground
11	P13	16	P0.13	GPIO
12	P18	21	P0.18	GPIO
13	P20	23	P0.20	GPIO
14	P021/RESET	24	P0.21/RESET	GPIO, configurable as RESET pin
15	SWDCLK	25	SWDCLK	Serial Wire Debug clock input
16	SWDIO	26	SWDIO	Serial Wire Debug I/O
A0	GND	45	VSS	Ground
A1	P28	40	P0.28/AIN4	GPIO, Analog input
A2	P29	41	P0.29/AIN5	GPIO, Analog input
A3	P04	6	P0.04/AIN2	GPIO, Analog input
A4	P05	7	P0.05/AIN3	GPIO, Analog input
A5	P07	9	P0.07	GPIO
B0	GND	45	VSS	Ground
B1	P25	37	P0.25	GPIO
B2	P30	42	P0.30	GPIO
B3	P31	43	P0.31	GPIO
B4	P06	8	P0.06	GPIO
B5	P08	10	P0.08	GPIO
C0	GND	45	VSS	Ground
C1	P24	29	P0.24	GPIO
C2	P22	27	P0.22	GPIO
C3	P17	20	P0.17	GPIO
C4	P15	18	P0.15	GPIO
C5	P12	15	P0.12	GPIO
D0	GND	45	VSS	Ground
D1	P23	28	P0.23	GPIO
D2	P19	22	P0.19	GPIO
D3	P16	19	P0.16	GPIO
D4	P14	17	P0.14	GPIO
D5	P11	14	P0.11	GPIO

Mounting BT832 on the Host PCB

The following figure shows recommended mounting of BT832 module on the host PCB.

- For the best Bluetooth range performance, the antenna area of module shall extend 6 mm outside the edge of host PCB board, or 6 mm outside the edge of a ground plane.

- The next choice is to place module on a corner of host PCB, the antenna area shall extend 6mm from the edge of ground plane. Ground plane shall be at least 5 mm from the edge of the antenna area of module.

- Bluetooth range performance is degraded if a module is placed in the middle of the host PCB.
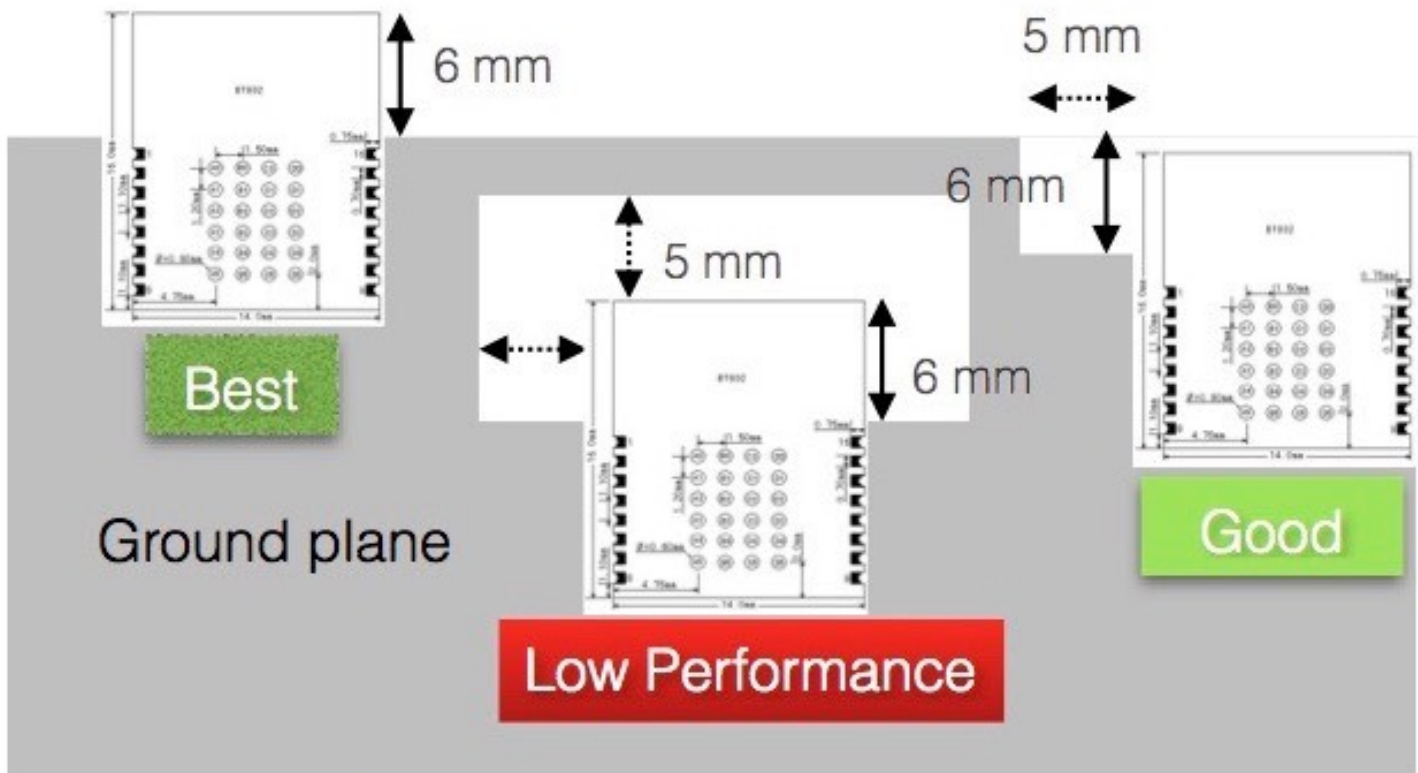
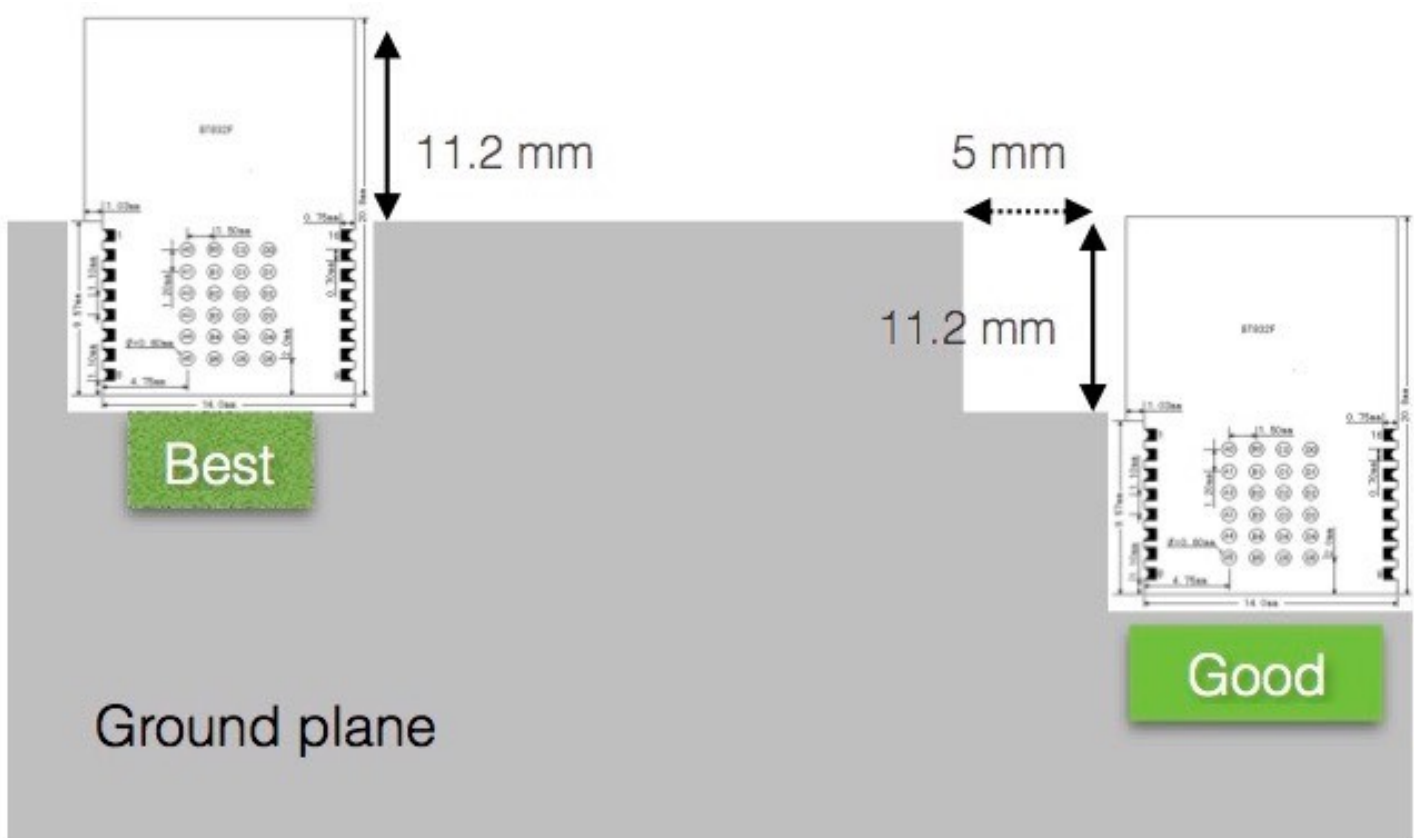1.BT832 module extends 6 mm from edge or ground plane of the host PCB board.
2.No ground plane on all layers for at least 5mm from edge of module. Longer distance for longer Bluetooth range.

Mounting BT832F on the Host PCB

The following figure shows recommended mounting of BT832F module on the host PCB.

• For the best Bluetooth range performance, the antenna area of module shall extend 11.2 mm outside the edge of host PCB board, or 11.2 mm outside the edge of a ground plane.

• The next choice is to place a module on a corner of host PCB, the antenna area shall extend 11.2 mm from the edge of ground plane. Ground plane shall be at least 5 mm from the edge of the antenna area of module.

• We don't recommend mounting BT832F module in the middle of a host PCB.

1.BT832F module extends 11.2 mm from edge or ground plane of the host PCB board.
2.No ground plane on all layers for at least 5mm from edge of module. Longer distance for longer Bluetooth range.

For the best Bluetooth range performance, keep all external metal at least 30mm from the antenna area.

4. AT Commands

AT command firmware for BT832 Series module is available. Please email info@fanstel.com.

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 6 of BT832) is pulled high, it is set to AT command mode. In AT command mode, the host processor communicates with the processor on BT832.

Command	Response	Parameter	example
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=<parm>	+UART:<parm>	Baud rate	AT+UART=115200/r/n +UART:115200,1,0 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=<parm>	OK or FAIL	+4~-8	AT+RFPW= 1/r/n 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 6 of BT832) is pulled low, it is set to data mode. In data model, BT832 provides transparent data transfer between the host processor and a remote device, for example, a smartphone.

5. BT832 Evaluation Board

Communicating with a PC

A quick and easy way to evaluate BT832 is to use a PC as the host processor. Connect the development board EV-BT832 to a PC with an USB cable. Then,

- Set S1, BT832 is set to command mode. PC will communicate with BT832.
- Set switch S1 to the other position, BT832 is set to data mode. PC will communicate with a remote device through BT832 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
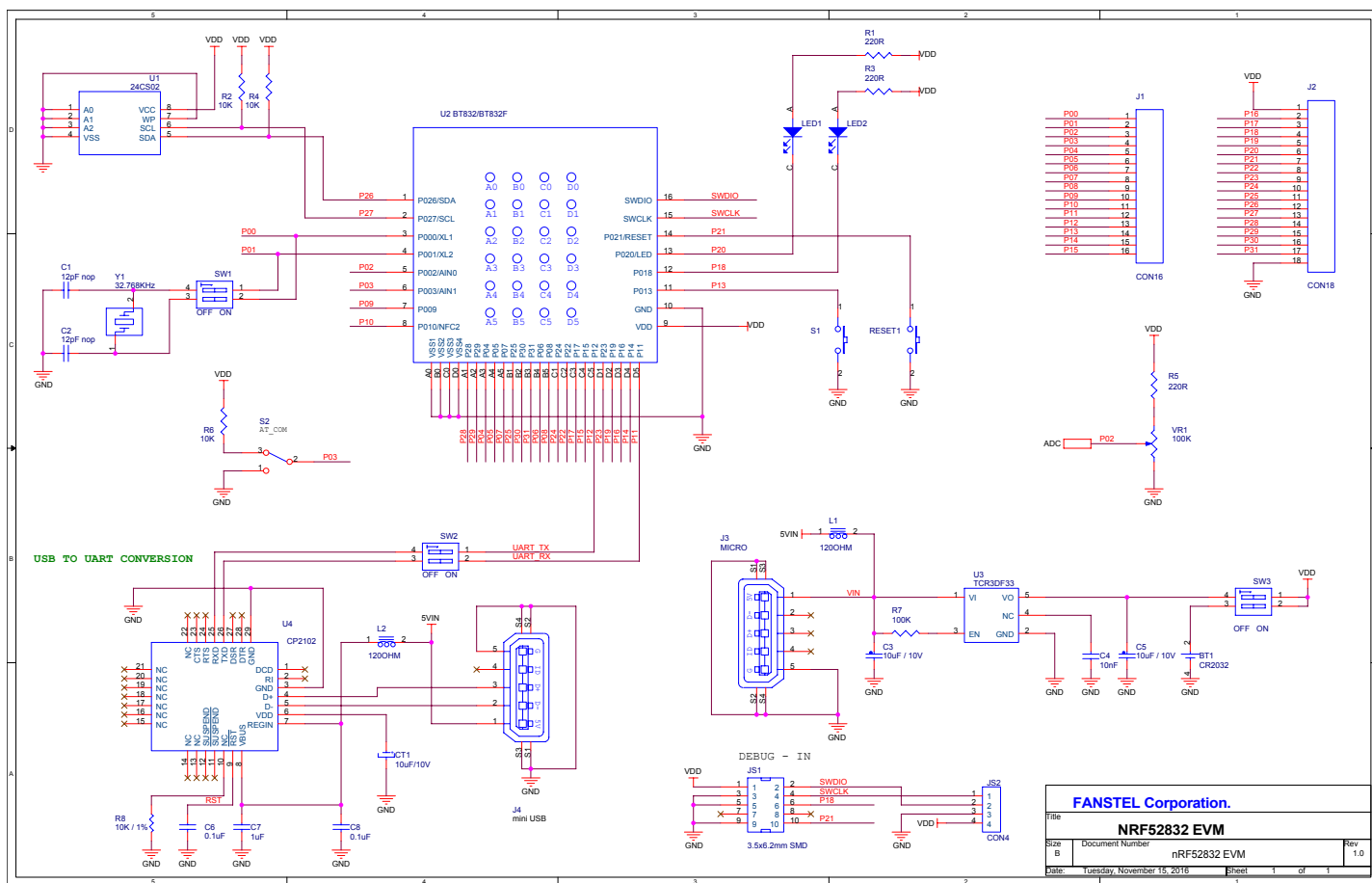
Evaluation Board Schematics

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 as shown in the upper left corner of the evaluation board schematics. The 32MHz main clock won't be active at idle state to save power.

Two inductors required for DCDC converter are inside BT832 module. You can enable DCDC to lower power consumption.

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.
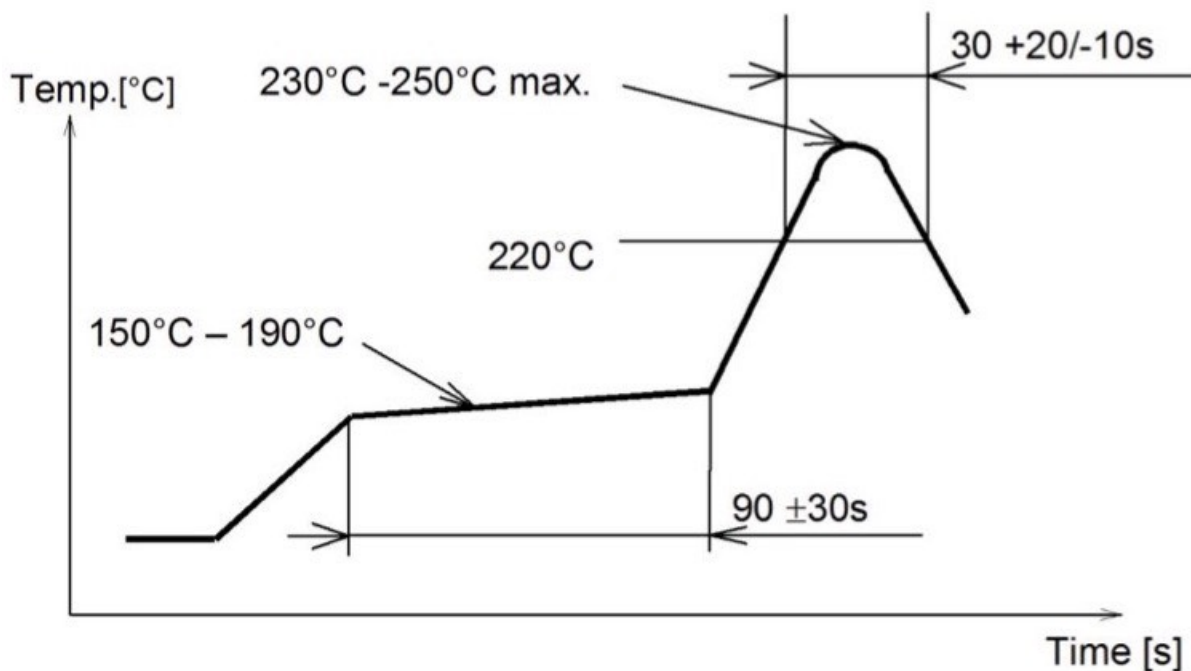
Cautions, Design Notes, and Installation Notes

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.

(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. 2.04: Update module photos

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